अर्धवार्षिक पत्रिका

विद्युत
VIDYUT

वर्ष २९ • अङ्क १ • २०७५ भदौ

नेपाल विद्युत प्राधिकरण

दरबारमार्ग, काठमाडौं

ऊर्जा, जलस्रोत तथा सिंचाइमन्त्री वर्षमान पुनलाई नेपाल विद्युत प्राधिकरणको प्राङ्गणमा स्वागत गर्नुहुँदै प्राधिकरणका प्रबन्ध निर्देशक कुलमान घिसिङलगायत अन्य कर्मचारी ।

अर्धवार्षिक पत्रिका

विद्युत
VIDYUT

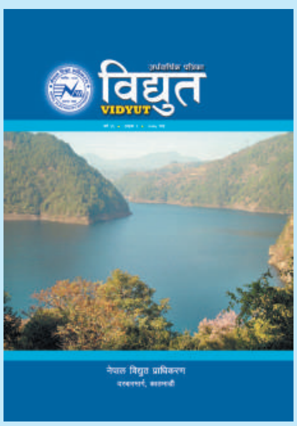
वर्ष २९ • अङ्क १ • भदौ २०७५

प्रकाशक
नेपाल विद्युत् प्राधिकरण
जनसम्पर्क तथा गुनासो
व्यवस्थापन शाखा
दरबारमार्ग, काठमाडौं
फोन. ४१५३०२१
आन्तरिक : २००२, २००३
फ्याक्स : ४१५३०२२
pro@nea.org.np

आवरण/लेआउट
अल मिडिया सोलुसन
बागबजार, काठमाडौं
फोन. ०१-४२५३९६४
९८५११२०८८०

मुद्रण
सुजल अफसेट प्रेस
बागबजार, काठमाडौं
फोन. ०१-४२५२८३४
९८५११२८३९४

यस पत्रिकामा छापिएका लेखरचना लेखकका निजी विचार हुन् ।
यसमा सम्पादन समिति जिम्मेवार हुनेछैन ।



आवरण तस्बिर
इन्द्र सरोबर

शुभकामना

शुभकामना

नेपाल विद्युत प्राधिकरणको प्रकाशन "विद्युत" बर्ष २९ अङ्क १ पाठकहरुसमक्ष प्रस्तुत गर्न पाउँदा खुशी लागेको छ।

जनतालाई नियमित, भरपर्दो र गुणस्तरीय विद्युत सेवा उपलब्ध गराउन प्राधिकरण प्रयासरत छ । बिभिन्न नीतिगत र सँस्थागत कार्ययोजनाहरुको पुनरावलोकन गरी सोको कार्यान्वयनबाट प्राधिकरणले पछिल्ला बर्षहरुमा केही उपलब्धिहरु हासिल गरेको देखिन्छ ।

सँस्थाले एक अर्बभन्दा बढी खुद मुनाफा आर्जन गर्न, करिब २६ प्रतिशतमा रहेको विद्युत चुहावटलाई करिब २० प्रतिशतमा झार्न सफल भएको छ । लामो समयदेखि निर्माणाधिन चमेलिया जलविद्युत आयोजना २०७४ चैत्र १ गतेदेखि सञ्चालनमा आएको छ भने २०७५ बैशाख ३१ गतेदेखि मुलुकभर नियमित विद्युत आपूर्ति भई देश लोडसेडिङ्ग मुक्त भएको छ । प्रदेश नं ७ अन्तर्गतका जिल्लामा आपूर्ति व्यवस्थापन गर्न सहज हुने डडेलधुरास्थित स्याउले १३२ केभी सबस्टेशन र उर्जा आयात निर्यातका लागि महत्वपूर्ण रहेको ढल्केबर २२० केभी सबस्टेशनको निर्माण सम्पन्न भई सञ्चालनमा आएको छ ।

१४ मेगावाटको कुलेखानी तेस्रो र ६० मेगावाटको माथिल्लो त्रिशुली ३ए जलविद्युत आयोजना यसै बर्षभित्र सम्पन्न गर्ने लक्ष्यकासाथ निर्माण भइरहेको छ । प्राधिकरणका सहायक कम्पनीहरुबाट ४५६ मेगावाटको माथिल्लो तामाकोशी, ३७ मेगावाटको त्रिशुली ३बी, ४० मेगावाटको राहुघाट, १४० मेगावाटको तनहुँ, १०२ मेगावाटको मध्यभोटेकोशी, १११ मेगावाटको रसुवागढी, ५७ मेगावाटको माथिल्लो तथा तल्लो साञ्जेन गरी कुल ९४३ मेगावाटका बिभिन्न जलविद्युत आयोजनाहरु निर्माण भइरहेका छन् । यसबाहेक ७२५ मेगावाटको माथिल्लो अरुण, ८२८ मेगावाटको उत्तरगङ्गा, ८०० मेगावाटको दुधकोशी, ९५ मेगावाटको तामाकोशी पाचौं, ६० मेगावाटको मोदी, ७६२ मेगावाटको तमोर र १८० मेगावाटको आँधिखोला जलविद्युत आयोजनाहरु पनि प्राधिकरणकै सहायक कम्पनीहरुमार्फत निर्माण गर्ने प्रक्रिया अघि बढाइएको छ ।

काठमाडौं उपत्यकाको आपूर्ति व्यवस्थापन गर्नका लागि २२० के.भी. रिङ्गमेन निर्माण गर्ने, महानगर तथा उपमहानगरपालीकाको वितरण प्रणालीलाई आधुनिकीकरण गर्ने, ग्रिड सबस्टेशनहरु अटोमेशन गर्ने, Battery Energy Storage System जडान गर्ने, प्राधिकरणको सेवालाई प्रविधिमैत्री बनाउन ERP System & Smart Meter/Grid System लागू गर्ने कार्य अगाडि बढाइएको छ । दीर्घकालिनरुपमा महत्वपूर्ण मानिएको पूर्व पश्चिम तथा उत्तर दक्षिण एवम् अन्तरदेशीय ४०० के.भी. प्रसारण लाइनहरु निकट भविष्यमा वित्तीय स्रोत जुटाई निर्माण गर्नका लागि आवश्यक अध्ययन गर्ने कार्यहरु भइरहेको छ ।

उर्जा क्षेत्रको बिकासगरी मुलुकको समृद्धि हाँसिल गर्न प्राधिकरणको भूमिका उल्लेख्य छ । समयसापेक्ष संस्थागत सुधार गर्दै प्राधिकरणलाई सक्षम ब्यावसायिक सँस्थाकोरुपमा बिकास गर्न र यसका समग्र काम कारवाहीलाई प्रभावकारी बनाउन नेपाल सरकार, दातृ निकाय, उपभोक्ता, ट्रेड युनियन, सम्पूर्ण कर्मचारीलगायत सम्बद्ध सबैबाट आवश्यक सहयोग र समर्थन प्राप्त भइरहने बिश्वास लिएको छु ।

आगामी दिनमा अझ उत्कृष्ट सामग्रीहरुसहित विद्युत पत्रिका प्रकाशन हुन सकोस् भन्ने शुभेच्छाकासाथ सम्पादक समूहलगायत प्रकाशनमा संलग्न सबैमा हार्दिक धन्यवाद व्यक्त गर्दछु ।

श्रावण २५, २०७५

(कुलमान घिसिङ)
कार्यकारी निर्देशक

सम्पादकीय

नेपाल विद्युत प्राधिकरणको नियमित प्रकाशन विद्युत वर्ष २९, अङ्क १ पाठकसमक्ष प्रस्तुत गरेका छौं । ऊर्जा क्षेत्रसँग सम्बन्धित विभिन्न लेख एवं जानकारी समावेश भएको यस अङ्कले यस क्षेत्रमा अध्ययन/अध्यापन गर्ने, नीति, निमार्ण गर्ने, विकास निर्माण गर्ने, संचालन र वितरण गर्ने तथा यस विषयसँग सरोकार राख्ने कर्मचारी, पत्रकार र आम नागरिकलाई सान्दर्भिक हुनेछ भन्ने विश्वास लिएका छौं ।

ने.वि.प्रा. ऐन, २०४१ अन्तर्गत यस संस्थाले विद्युत उत्पादन, प्रसारण र वितरणको क्षेत्रमा हालसम्म एकीकृत रूपमा काम गरिरहेकाले यसमा कार्यरत कर्मचारीले उपरोक्त सबै क्षेत्रको कार्यानुभव र विज्ञता हासिल गरेको र सोहीबमोजिम विद्युत पत्रिकाका विभिन्न अङ्कमा आफ्नो सैद्धान्तिक ज्ञान, व्यावहारिक अनुभव र नवीनतम अभ्यासलाई आफ्नो लेखरचनामार्फत् प्रतिबिम्वित गर्नु भएको देखिन्छ ।

नेपाल सरकारले लिएको नीतिअनुरूप विद्युत् नियमन आयोग ऐन, २०७४ जारी भएको अवस्थाले सृजना हुने प्रतिस्पर्धात्मक वातावरणले अझ उत्कृटता हासिल हुने र सोहीबमोजिमका सान्दर्भिक लेख रचना प्राप्त हुने अपेक्षा गरिएको छ ।

ऊर्जा क्षेत्रसँग सम्बन्धित रचनाहरू 'विद्युत' पत्रिकाले समेट्ने प्रयास गरिरहेकाले यस क्षेत्रको अध्ययन र अध्यापन क्षेत्रमा कार्यरत रहेका प्रवुद्ध व्यक्तित्व, निजी क्षेत्रका ऊर्जा उत्पादक, वैकल्पिक उर्जा क्षेत्रमा कार्यरत व्यक्तित्व, ने.वि.प्रा.का विभिन्न क्षेत्रमा कार्यरत व्यक्तित्व, यस क्षेत्रलाई नजिकबाट अध्ययन गर्ने पत्रकार, आम नागरिकको तर्फबाट अध्ययनमूलक, खोजमूलक, समस्या समाधानमूलक सिर्जनशील लेख/रचनाको अपेक्षा गर्दछौं ।

यस पत्रिकामा प्रकाशित लेख/रचनामा विद्धेष फैलाउने, भ्रम सिर्जना गर्ने र लाञ्छना लगाउने जस्ता शब्दलाई परिमार्जन गर्ने तथा स्थान अभावका कारण लेख रचनाभित्रको केही असान्दर्भिक तथ्य, तथ्याङ्क र अंशलाई मूल मर्ममा परिवर्तन नहुने गरी व्यवस्थित गरिएको छ । लेख/रचनामा अभिव्यक्त भावना लेखकका निजी विचार भएकाले त्यसलाई सम्मान गर्दै उत्कृष्ट लेख/रचनालाई यस अंकमा प्रस्तुत गरेका छौं । साथै, स्थान अभावका कारण प्राप्त लेख/रचनामध्ये केहीलाई स्वीकृत गरी आगामी अङ्कमा प्रकाशित गर्ने निर्णय गरिएको व्यहोरासमेत जानकारी गराउन चाहन्छौं ।

अन्त्यमा, ऊर्जा क्षेत्रसँग सम्बन्धित विविध विषयमा स्तरीय लेख/रचना एवं विवरण उपलब्ध गराई सहयोग पुऱ्याउनुहुने लेखक, सम्बद्ध पक्ष एवं कर्मचारी सबैमा हार्दिक आभार व्यक्त गर्दै आगामी दिनमा समेत रचनात्मक सहयोगको अपेक्षा गर्दछौं ।

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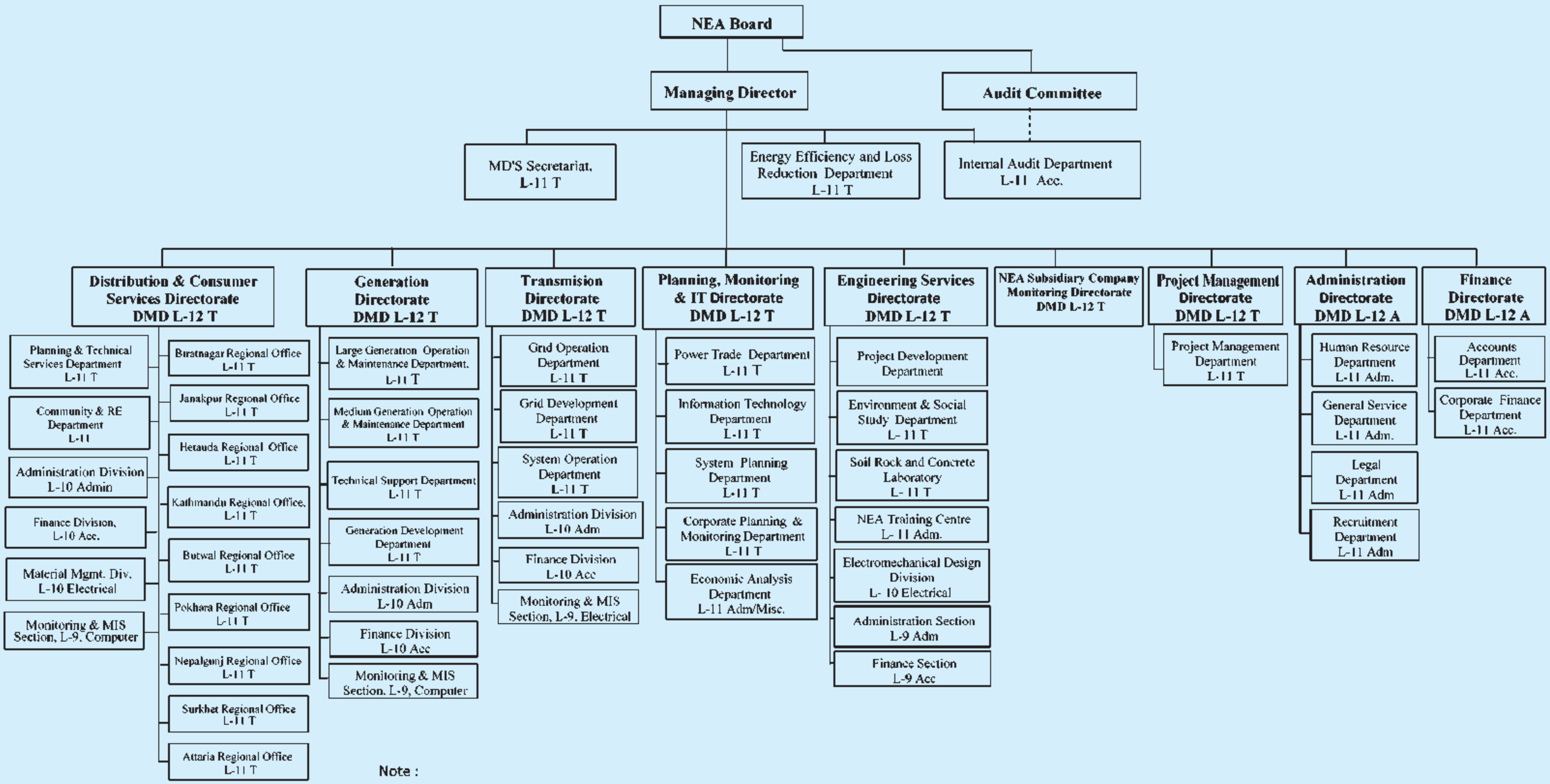
रचनाक्रम

Organization Structure of Nepal Electricity Authority



Note :
T = Technical Services; A = Administration Services: Adm = Administration Group:
Acc=Account Group

नेपालमा विद्युत वितरण एवं ग्राहक सेवा

टेकनाथ तिवारी
प्रमुख, कुलेश्वर वितरण केन्द्र, नेपाल विद्युत प्राधिकरण

(क) पृष्ठभूमि

नेपालका धेरै भूभाग अहिले पनि विद्युतविहीन अवस्थामा छन् । धेरैजसो ठाउँमा छरिएर रहेका बस्ती, विना कुनै योजना जहाँ आ-आफ्नो जग्गा छ वा मिल्छ, त्यही घर बनाएर बस्ने अनिसोपश्चात् आवश्यक पूर्वाधार खोजिने र सरकार पनि सोहीअनुरूप कार्य गर्दै जाने परिपाटिमा रहेकाले सबै नेपालीले विद्युत् पाउन अझै केही वर्ष लाग्नेछ । विद्युत् विस्तारको प्रचलित प्राक्टिसमा पहिले स्थानीयबीच विद्युत् प्रयोग गराउन Isolated हिसाबमा चल्ने गरी डिजेल प्लान्ट वा Micro-hydro बाट बेलुकी बालिने टुकी/मैनबत्तिको उज्यालो प्रतिस्थापन गर्नलाई सञ्चालन गर्दै पछि Integrated Nepal Power System (INPS) मा जोडि विद्युतीकरण गर्ने गरिएको छ । विभिन्न ठाउँमा विद्युत् सेवाका लागि नेपाल विद्युत् प्राधिकरणको प्रतिनिधिमूलक संस्थाका रूपमा वितरण केन्द्र स्थापना गर्दै सेवा नियमित गर्ने गरिएको छ । यसअघि प्रकाशित अङ्कमा नेपालमा विद्युत विकासबारेको इतिहासबारेमा आइसकेकाले त्यसलाई यहाँ पुनरावृत्ति गरिएन ।

ने.वि.प्रा.को एक जिम्मेवार व्यवसायको रूपमा वितरण तथा ग्राहक सेवा निर्देशनालय रहेको छ, जसअन्तर्गत विभिन्न क्षेत्रीय कार्यालय र सो मातहत वितरण केन्द्र रहने गरी संरचनात्मक गठन भई विद्युत वितरण तथा ग्राहक सेवाको कार्य हुने गरेको छ । वितरण केन्द्रले प्रत्यक्ष रूपमा जनतासँग समन्वय गरी कार्य गर्ने भएकाले त्यहाँबाट सम्पादित कार्यले समग्र ने.वि.प्रा.बारे ग्राहकको छाप बन्न जाने कुरामा दुईमत हुन सक्दैन ।

वितरण केन्द्रमा रही कार्य गरिरहँदा त्यहाँ देखिएका, भोगिएका समस्यालाई न्युनीकरण गरी चुस्तदुरूस्त सेवा दिनका लागि गर्नुपर्ने सुधार (हामी जस्तै युटिलिटी अन्य देशमा पनि रहेकाले त्यहाँ उनीहरूले गर्ने गरेका राम्रा प्राक्टिसलाई नक्कल गरी सुधारको सुरूआत गर्ने हो भने सायद फरक किसिमले जानुपर्छ कि ?) का केही पक्षलाई मात्र गर्नसके दिइने सेवामा सुधार हुनेछ । 'यस पत्रिकामा छापिएका लेख/रचना लेखकका निजी विचार हुन् । यसमा सम्पादन समिति जिम्मेवार हुनेछैन' भनी विद्युत् पत्रिकामा लेख प्रकाशित हुने भएकाले यसमा नितान्त आफूले देखिजानेको, पढिजानेका कुरा, जसले वितरण केन्द्रलाई सुधार गर्न केही मात्र भए पनि टेवा पुर्‍याउने छ भनी केही विषयमा व्यक्तिगत विचार प्रस्तुत गर्ने जमर्को गरेको छु ।

(ख) वितरण केन्द्रको सेवा र व्यवस्थापकीय सुधार

वितरण केन्द्रमा प्राविधिक सेवा तथा प्रशासन सेवाअन्तर्गतका कर्मचारी विभिन्न फाँटमा रही आ-आफ्नो कार्यमा एकअर्कासँग समन्वय गरी अन्ततः ग्राहक सेवाका कार्य गरिरहेका हुन्छन् । त्यहाँ सम्पादन गरिने कार्यलाई सहज गर्ने सम्बन्धमा यथाशीघ्र तपसिलका विषयमा बहस हुन आवश्यक छ ।

१. कार्यालय तथा कर्मचारी व्यवस्थापन गर्नेबारे

प्रत्येक कार्यालयले सेवाग्राहीलाई प्रदान गर्ने सेवाका सन्दर्भमा कार्य सम्पादन गर्न कुन, कुन कार्य के, कसरी गर्ने, गराउने भनी स्पष्ट गर्न गराउन सर्वप्रथम "Organization

Chart" बनाउन आवश्यक छ । हामी कुन संरचनालाई आधार मानी कार्यालय सञ्चालन गरिरहेका छौं, भन्दा ठोस उत्तर दिन सक्ने अवस्था छैन ।

वितरण केन्द्रमा कुन-कुन फाँट हुने ? उक्त फाँटले गर्नुपर्ने कार्यको स्पष्ट व्याख्या गर्न आवश्यक छ । एक द्वार गर्न सकिने कार्य पनि स्पष्ट खाकाको अभावमा दुईतीनवटा फाँटले हेर्ने र कार्यालयमा खटिआउने जनशक्तिअनुसार फाँट बनाइने प्रचलन रहेको छ । कार्यालय प्रमुख, लेखा प्रमुख, प्रशासन प्रमुख र स्टोर प्रमुख (स्टोर प्रमुखको जिम्मेवारी तोकेर पठाइने भनिए पनि हालसम्म गरिएको रेकर्ड प्राप्त गर्न सकिनँ) ४ जनालाई व्यवस्थापनबाट जिम्मेवारी तोकि पठाउने अनी अन्यलाई कार्यालय प्रमुखले काम तोकि कार्य सम्पादन गरिने प्रचलन छ ।

आ.व. २०७४/७५ सम्म १०,००० कर्मचारी नै हुन्, उनीहरूले पहिले कार्य गरेका स्थान, सम्पादन गरेका कार्यका विवरण केन्द्रमा अद्यावधिक गर्न आवश्यक छ । ने.वि.प्रा.को Website मा निज कर्मचारीको विवरणलाई अद्यावधिक गरी व्यवस्थापनले हेर्न मिल्ने गरी Online Database तयार गर्ने । हाम्रो फिल्डको विज्ञ हामी नै हौ, विज्ञताको पहिचान गरी विवरण अध्यावधिक गर्न सके हाम्रै जनशक्तिबाट धेरै कार्य लिन सकिनेछ ।

कार्यालयको आवश्यकताअनुसार कर्मचारीलाई कार्यालयमा खटाउन पहल गर्नुपर्नेछ । हालको अवस्थालाई मनन गरी विज्ञता अध्यावधिक गरी (३ महिनामा गर्न सकिन्छ), पहिलोपटक गर्नुपर्ने काम तथा फाँट विषेश नै तोकेर खटाउन आवश्यक छ । यहाँ O&M Survey भयो, दरबन्दी बढेको छ भन्नेसम्म सुनिएको छ तर मोडालिटी कस्तो हो भन्ने थाहा पाउन सकिएन । संस्थामा भएको कटुसत्य २५ प्रतिशत भन्दा बढी कर्मचारीले आफनो सेवा समूहअनुसार कार्य गर्न पाएका छैनन् वा गरेका छैनन् ।

कर्मचारी नियुक्ति लिंदा पदीय जिम्मेवारीअनुसार कार्य गर्नेछु भने पनि पछि विविध कारणले तोकिएको काम गर्न सक्ने भए पनि पन्छिने गरेका छन् । तसर्थ, कुनै पनि पदकाले गर्नुपर्ने कार्यको कम्तिमा एक हप्ताको "On the Job Training" दिने व्यवस्था गरी सम्बन्धित सेवा समूहको कार्य गर्न, गराउन कार्य सम्पादनमा सुपरीवेक्षक र मूल्याङ्कनकर्तालाई लेखिएको फरक पाइए निजको मूल्याङ्कन काटिने व्यवस्था गरे विशेष निर्णयको अवस्था बाहेक फरक कार्य गराउने छैनन् ।

यसले कार्यरत कर्मचारीलाई तालिम तथा उत्प्रेरणाको कमी भएको मनन गर्न सकिन्छ ।

स्पष्ट भन्दा भएको व्यवस्थाको बर्खिलाप हुने गरी प्रस्तुत भएको बुझिएला, तर पदले गर्नुपर्ने कार्यका कारण केही पदमा प्राधिकरणको सेवालाई समावेशी बनाउन गरिएको आरक्षणलाई रूजु गरी संशोधन गर्न मनासिव हुनेछ ।

हाल अनिवार्य अवकाश एवं स्वेच्छिक अवकास हुँदा संस्थाले दिएको सक्कल परिचयपत्र फिर्ता गर्नुपर्ने भन्ने परिपत्र प्राप्त भएकाले संस्थाले नियुक्ति गर्दा, सरूवा गर्दा तथा बढुवा हुँदाका बखत पत्रका साथ परिचयपत्र दिने व्यवस्था गर्न आवश्यक छ । जुनसुकै कार्यालयमा हुँदा परिचयपत्र बनाउन सकिने, हरायो भने फेरि बनाउन सकिने अवस्था हुँदा परिचयपत्र फिर्ता गर्नुको अर्थ रहँदैन बरू परिचयपत्रमै केही विवरण थप गरौं, स्वतः स्पष्ट होस् ।

२. मिटर रिडिङ तथा महशुल अद्यावधिक गर्ने कार्य

विद्युत् प्राधिकरणको एक मात्र प्रतिनिधि, जो प्रत्येक महिना ग्राहककोमा पुग्छ, त्यो विशेष जिम्मेवारी भएको व्यक्ति भनेको मिटररिडर नै हो । जबसम्म मिटररिडर ग्राहककोमा गई बिल दिने व्यवस्था रहन्छ, तबसम्म मिटररिडिङ कार्य नेविप्राले आफ्नो जनशक्तिबाट गराई निजलाई प्राविधिक ज्ञान दिई अझ सबल बनाउन आवश्यक छ (काठमाडौंस्थित कुनै एक वितरण केन्द्रले सेवा करारमा लगाएको विषयको अध्ययन गर्न आवश्यक छ) ।

मिटररिडरले ग्राहकलाई उपलब्ध गराएको बिलअनुसार खपतमा सही, गलत भन्न सक्ने अवस्थाको बुझाई तथा अध्ययन अनिवार्य गरी मिटररिडिङ गर्ने कार्यका जनशक्तिको सेवा प्राविधिक गरी तीन तहदेखि पाँच तहसम्म अनिवार्य रूपमा रिडिङ गर्ने गरी जनशक्ति व्यवस्थापन गर्ने गरी विनियम संशोधन गर्न आवश्यक छ ।

मि.रि., सि.मि.रि एवं मि.रि.सु.भा.लाई बाहेक अन्य सेवा समूहका कर्मचारीलाई अन्य फाँटमा काम दिने अवस्था नभए वा कर्मचारीको इच्छाका कारण मिटर रिडिङ्गमा खटाउने कार्य बन्द गर्न सक्ने गरी कर्मचारी खटाउन पहल गर्न एकपटक सेवा, समूह, उपसमूह परिवर्तन गर्न दिने गरी व्यवस्थापनले निर्णय गर्न आवश्यक छ । बीसौं वर्ष प्राविधिक मान्छे काउन्टरमा बसेर सेवा गरेकोमा सरूवा भई जाँदा सुपरभाइजर पदको व्यक्तिलाई नोलाइटमा तोकिएपछिको पीडा आँखा अगाडि छ । यो समस्यालाई मनन गरी समाधान गर्न आवश्यक छ ।

मिटररिडिङ डिभाइसमा मिटररिडरले खोलेका फाइलका लग विवरण रहने र कार्यालयको Admin को जिम्मेवारी भएको व्यक्तिले हेर्न मिल्ने बनाई निज मिटररिडरलाई ग्राहकको कम्तिमा ६ महिनाको विवरण हेर्न मिल्ने गराउन उपयुक्त हुनेछ ताकि बिल थोरै धेरै भएजस्तो कैफियत लागेमा साइटमै रूजु गरी यकिन गर्न सकियोस् ।

३. ग्राहक नम्बर, महसुल एवं सेवा शुल्क सङ्कलन कार्य

महशुल संकलन कार्यका लागि ग्राहकको विलिङ्ग तथा विवरणलाई Central Server मा राख्ने व्यवस्था हुन आवश्यक

छ । अनलाइन गर्न सकिने प्रविधि भएकाले सोलाई प्रयोग गरी ठाउँ-ठाउँमा भएको लोकल सर्भर हटाउन आवश्यक छ । पहिलो चरणका लागी कम्तिमा काठमाडौं उपत्यकामा भएका ग्राहकको विवरण एकीकृत गरी सेन्ट्रल सर्भरमा राख्न पहल गरौं । साथै सोका लागि ग्राहक नम्बरलाई वैज्ञानिक तवरमा संशोधन गरी भोली देशभरीका ग्राहक नम्बर नदोहोरिऊन् भन्न तपसिलअनुसार ग्राहक नम्बरलाई १० अङ्कको बनाउन छलफल गर्नुपर्नेछ ।

क्षेत्रीय कार्यालय -१
(प्रादेशिक हिसाबमा गर्दा बढीमा ७ हुने भएकाले)

वितरण केन्द्रलाई - २

एरियालाई - २

रिडिङ्ग गतेलाई - २

ग्राहक वर्गीकरणसहितको नम्बरलाई -३ (एकदिन रिडिङ हुने ग्राहक संख्या ९९ मा सीमित गर्ने हो भने तेस्रो अङ्कलाई अंग्रेजी लेटर बनाई २६ वर्गसम्मको ग्राहक हो भनी किटानी गर्न ग्राहक वर्गीकरण समेतलाई मिलाउन सकिन्छ- 1010101D01, ऋफ २ अङ्क थपि १२ गर्ने हो भने थप २ विषय थप्न सकिन्छ ।)

यसरी नम्बर राख्ने व्यवस्था भए देशभरिका ग्राहकको नम्बर फरक-फरक हुने र भोलि केन्द्रीय सर्भर राख्न सहज भई सबै वितरण केन्द्रलाई अनलाइन गर्दा बैङ्कहरू जस्तो Any Branch Payment System लागू गर्न सकिन्छ ।

हाल वितरण केन्द्रबाट अनलाइन बैङ्क तथा विकास बैङ्कमार्फत्महशुल संकलन गर्ने कार्य सुरू भइसकेकाले ग्राहकको बिल समयमै अद्यावधिक गर्न आवश्यक छ, तर मिटररिडरको समस्याले त्यो १०० प्रतिशत हुन सकिरहेको छैन । सोमा ढिला हुँदा नेविप्राको छवि बिग्रनेमा दुईमत छैन । यो समस्यालाई मनन गर्दा थ्रिफेज र टिओडीको रिडिङ्ग नियमित गर्ने गरी सिङ्गलफेज ग्राहकको हकमा सुरूमा तीन महिना नियमित रिडिङ्ग गर्ने र सो पश्चात रिडिङ्ग मितिमा स्वतः अघिल्लो तीन महिनाको औसत गरी बिल गर्ने र कम्तीमा ६ महिनामा कुनै पनि दिन मिटर रिडर/चुहावट टोलीले छड्के गरी रिडिङ्ग वा रिसिलिङ्ग गर्ने व्यवस्था गरिएमा कम जनशक्तिबाट रिडिङ्ग कार्य सम्पादन गर्न सकिनेछ । अब अनलाइन पेमेन्ट लागू गरिएका प्रत्येक वितरण केन्द्रमा २/३ वटा मात्र काउन्टर व्यवस्था गरी महसुल भुक्तानी Online मार्फत् गर्न ग्राहकलाई विश्वस्त पार्ने विज्ञापन तथा सुसूचित गर्ने Campaign गर्न आवश्यक छ ।

४. ग्राहकका लगत अद्यावधिक गर्ने

कार्यालयमा रहनुपर्ने विवरणलाई अद्यावधिक गर्न Document Scan गर्दै Central Server मा विवरण राख्ने व्यवस्था गर्ने । स्क्यान गरी राखिने विवरणको फर्मेट र आवश्यक डकुमेन्टका बारेमा पुनः विनियममै संशोधन गरी स्पष्ट किटानी गर्ने ।

M-Power मा नै लगत अपडेट गरी राख्न File Attach गर्ने व्यवस्था गर्ने ।

एक ठाउँमा विद्युत् लिन पेश गर्दा अर्को कुनै ठाउँमा आफ्नो तीन पुस्तेभित्र विद्युत लिइएको विवरण अनिवार्य रूपमा ग्राहकलाई भर्न लगाउने ।

विनियममा उल्लेख गरी आवश्यक भनिएका विवरणका सन्दर्भमा कानुनी, प्रशासनिक एवं प्राविधिक रूपमा स्पष्ट हुन छलफल गर्नुपर्ने (अन्य देशको आधार लिन मनासिब हुने) ।

५. वितरण ट्रान्सफरमर, पोल, तार/केवलका सन्दर्भमा

सहरी एरियाका मुख्य बाटोमा १२/१४ मिटरका पोल राखी विद्युत् वितरण प्रणाली बनाउन उचित हुनेछ (अण्डरग्राउण्ड गर्ने कार्य अवलम्बन नगर्दा सम्म/पछि सहर भित्र अण्डरग्राउण्ड भएमा सहर छेउमा पुनः प्रयोग गर्न सकिन्छ) ।

विदेशमा काठका पोल प्रयोगमा छन्, यहाँ प्रयोग गर्नु हुँदैन भन्ने पनि छैन । तसर्थ, सो सम्बन्धमा फलानो फलानो रूखको यति समयावधि भएको काठको मात्र पोल प्रयोग गर्ने भन्ने स्पष्ट स्पेशिफिकेशन बनाउन आवश्यक छ ।

वितरण ट्रान्सफरमर हाल दुई पोल राखी टावर बनाइराख्ने गरिएकोमा एकल पोलमा जडान गर्न सकिने खाल्का समेत खरिद गर्न Specification बनाई कार्यान्वयन गर्ने ।

सहरी क्षेत्रका लागि बढीमा ११/०.४ केभि, ५०० केभिएसम्मका ट्रान्सफरमर खरिद गर्ने ।

विद्युतको माग बढाउन १०० के.भि.ए.सम्म स्वीकृत क्षमताका लागि ने.वि.प्रा.ले ट्रान्सफरमर उपलब्ध गराउने (हाल ५० केभिएसम्म नेविप्राको ट्रान्सफरमरबाट दिने व्यवस्था छ) ।

एबिसि केवल राखी वितरण लाइन बनाउन र एकफेज मात्र तान्दा हुने ठाउँ छ भने त्यहाँका लागि इन्सुलेटेड एलटि कन्डकटर जडान गर्ने गरी इष्टिमेट एवं कार्य गर्ने ।

काठमाडौं उपत्यकामै लामो लामो एलटि लाइन तानी विद्युत् वितरण लाइन तान्ने गरिएको छ । ट्रान्सफरमर बाटोमा राखी २/३ सर्किट एबीसी केबल तानी ग्राहकलाई विद्युत् आपूर्ति गर्ने गरिएकोमा समन्वय गरी ११ केभि अण्डरग्राउण्ड गरी लोड सेन्टरमा ट्रान्सफरमर राख्ने व्यवस्था गर्ने ।

पोल, ट्रान्सफरमर राख्ने कार्यमा अवरोध पुऱ्याउनेलाई सेवा दिन सकिँदैन भन्ने सूचना जारी गरी साँच्चि नै, त्यसको कारण असहज भएको हो भनी आएमा त्यहाँ नेविप्राले विद्युत् उपलब्ध गराउन बाध्य हुने छैन भन्ने व्यवस्था गर्ने ।

६.११ के.भि. तथा ३३ के.भि. मझौला भोल्टेजका लागि तानिएका लाइनका सन्दर्भमा सम्पूर्ण फिडरलाई GIS Map मा अपडेट गरी डाटावेस अद्यावधिक गर्ने । Google Earth मा राख्ने विषयमा छलफल गर्न आवश्यक छ ।

११ केभी तथा ३३ केभीका लाइनको लोडका आधारमा बढीमा यति कि.मि.सम्म तान्ने र सो भन्दा बढी हुने अवस्थामा माथिल्लो भोल्टेजको लाइन लाने भन्ने व्यवस्था गर्ने (बुटवल/भैरहवा वितरण केन्द्रबाट तानिएको ३३ केभी औद्योगिक फिडरमा २० प्रतिशत लस हुँदाहुँदै हामीले ठूलो उद्योग नजिक हुने गरी १३२ केभी/३३ केभीको सबस्टेशन बनाउन पहल गरिएको छैन) ।

लाइनका लागि कन्डक्टर छनौट गर्दा प्राविधिक/आर्थिक मात्र नहेरी भोलिको आवश्यकता र सो लाइनबाट लिन सकिने फाइदालाई पनि हेर्ने कि ? साथै सिङ्गल सर्किट नै ठीक कि डबल गर्ने भन्ने सन्दर्भमा विस्तृत छलफल गर्ने कि ? (समस्याः चक्रपथ विस्तारका क्रममा पुल्चोक वितरण केन्द्रले बाटोको दुवैतर्फ डबल सर्किट राख्यो तर सँगैकाले एक) ।

हालै २२ केभिको लाइन पनि जडान गर्ने भनी छलफल चलाइएकोमा धेरै भोल्टेजको व्यवस्था हुनु संस्थाका लागि सही नहुने (भियतनामले बीचका विभिन्न भोल्टेज लेभललाई हटाउँदै गएको कुरालाई मनन गर्ने कि ?) ।

(ग) केन्द्रीय व्यवस्थापनबाट हुने कार्य-सम्पादनमा सुधार गर्ने

वितरण केन्द्रमा भइरहेका धेरै कार्यमा केन्द्रीय व्यवस्थापनका परिपत्र, निर्देशन एवं मौजुदा विनियमले प्रभावकारी भूमिका खेल्छ, Hierarchy का आधारमा चलेको संस्था सञ्चालनको सिद्धान्त नै त्यही हो । व्यवस्थापनबाट केही तपसिलका विषयबारेमा सुधार गर्न आवश्यक छ ।

१. प्रयोगमा भइरहेका मिटर, सिटि/मिटरिङ युनिट तथा इस्टिमेटका सन्दर्भमा

सिङ्गल फेज मिटर धेरै पुराना हुँदा पनि प्रयोगमा हुनु र जडित स्थानका समस्याका कारण त्यसको एक्कुरेसीमा कमी हुने हुनाले आवधिक रूपमा (जस्तो कि १० वर्ष पुराना मिटर, सिटी क्वायल आदि) ग्राहकलाई मूल्य तिराई बदली गर्ने (भियतनामको प्राक्टिस) ।

स्मार्ट मिटर जडान गर्न अविलम्ब शुरू गर्ने ।

२५ केभिएभन्दा माथिको ग्राहककोमा डिमान्ड मिटर राख्ने विनियममा भएको व्यवस्थाअनुसार सबै TOD मिटर जडान गर्नेतर्फ पहल गरी इलेक्ट्रोमेकानिकल सिटी अपरेटेड मिटर बदली गर्न आवश्यक छ । साथै ३०/१२० ए., थ्रि फेज, इलेक्ट्रोमेकानिकलको मिटर हटाउन पहल गर्ने ।

सिटि क्वाइल बदली गर्ने साथै २/३ टर्नका समेत प्रयोगमा भएकालाई सिङ्गल टर्न राख्ने ।

एच.टि. मिटररिडिङ युनिट जडान गर्न स्वीकृत क्षमतालाई आधार मानी बढीमा एक स्टेप माथिको जडान गरे ठीक र अन्य सुधार गर्ने भनी परिपत्र गरी सुधारको पहल गर्ने ।

सुधारका क्रममा साइटमै गई आवश्यकताअनुसार TOD Meter Reprogramming र Replacement गर्ने व्यवस्था गर्ने ।

ने.वि.प्रा.ले बोलपत्रमार्फत् मिटर खरीद गरिरहँदा १० वर्षभित्र ४ थरिका TOD मिटर आएकामा कम्तीमा १० वर्षसम्म एकै कम्पनीको राख्न आवश्यक पहल गर्ने ।

वितरण केन्द्रले ग्राहकसँग लिने विभिन्न कार्यका संस्थागत इष्टिमेटमा नै फरक छ, एकरूपता गर्न परिपत्र गर्ने ।

सार्कभित्रका अन्य देशका प्रचलित प्राक्टिसलाई अनुसरण गर्ने कि ?

२. विद्युत् उत्पादन बढाउनुका साथै खपत बढाउन पहल गर्नुपर्ने विषयका सन्दर्भमा

विद्युत् उत्पादन स्टेपमा एकैपटक १००औं मेगावाट आउने र माग बढ्ने कार्य स्टेपमा नभई निरन्तर हुने अवस्थालाई मनन गरी देशमा विद्युत् उत्पादन गर्ने स्पष्ट रोड-म्याप बनाई सो को फरकलाई समायोजन गर्ने क्षमताका लागी विद्युत आयात सम्झौता गर्ने ।

नियमित विद्युत आपर्ति भएपश्चात् अब पेट्रोलियम पदार्थलाई विस्थापन गर्नेतर्फ योजना बनाई प्रणाली व्यवस्थित गरी विद्युत्को खपत बढाउन पहल गर्ने ।

भोलिका दिनमा यातायात सेक्टरले बढी विद्युत् प्रयोग गर्ने अवस्थालाई मनन गरी सोही अनुसार सम्बन्धित निकायसँग समन्वय गरी देश विकासमा हातेमालो गर्ने ।

३. औद्योगिक/व्यापारिक/बसोबासका क्षेत्र किटान गरी लाइन व्यवस्थापन गर्ने सन्दर्भमा

विद्युत्को उपलब्धता, गुणस्तर एवं ग्राहक वर्गको आवश्यकतालाई मनन गरी नेपाल सरकारका अन्य जिम्मेवार निकायसँग एरिया वर्गीकरण गर्न सकिन्छ/सकिंदैन भन्ने विषयमा छलफल गर्ने ।

प्रत्येक एरियामा विद्युत् आपूर्तिका लागी कम्तीमा २ वटा सबस्टेशनबाट फिडर ल्याई विद्युतीकरण गर्ने गरी व्यवस्था गर्ने ।

उद्योगहरूले लिने लोड ३ सिफ्ट चल्नेका हकमा लगभग एकैनाशका हुने हुनाले Base Load का ग्राहक मानी महशुल कम गर्ने गराउने प्रचलन भएकोमा नेपालको सन्दर्भमा खरिद दरमा चुहावट प्रतिशत एवं संस्थागत सञ्चालन खर्चले

थपिने मूल्य समायोजन गरी कम्तीमा सो महशुल लिने व्यवस्था गर्न आवश्यक छ । सिजनल ट्यारिफमा समेत त्यो समायोजन भएको पाईदैन ।

व्यापारीक एवं ग्राहस्थ क्षेत्रमा ऊर्जा बचत गर्न सकिने उपकरण प्रयोग र विधिबारेमा अभिप्रेरित गर्ने ।

४. स्वीचिङ्ग स्टेशन तथा सबस्टेशन थप गर्ने सन्दर्भमा

योजनाबद्ध रूपमा भोलिको बढ्दो माग सम्बोधन गर्न सकिने गरी हालको र भोलि हुनसक्ने क्षमताको यकिनसहित सबस्टेशन तथा स्वीचिङ्ग स्टेशन अध्ययन गरी थप गर्ने ।

नयाँ सबस्टेशन नोम्यानका हिसाबमा चलाउने प्रविधिलाई अनिवार्य गर्ने ।

थानकोट-चापागाउँ-भक्तपुर १३२ केभि लाइन यथाशीघ्र बनाउनका लागि (Re-route गरी भए पनि) पहल गर्ने । यही अवस्था रहेमा काठमाडौं उपत्यकाका फिडर तथा सबस्टेशनले माग सम्बोधन गर्न नसक्ने र साथै प्रणालीको Availability र Reliability बारे समस्या हुनेछ ।

५. वितरण केन्द्र थप गर्ने प्राक्टिसका सन्दर्भमा

ग्राहक संख्या बढदै जाने र यति भन्दा बढी भयो भने वितरण केन्द्र टुक्र्याउने कार्यले ग्राहक सेवा सहज हुन्छ भन्ने छैन । संस्थागत रूपमा सेवालाई व्यवस्थित गर्न एक जिल्लामा एउटा मात्र वितरण केन्द्र बनाउने (ललितपुरमा पुल्चोक वितरण केन्द्रलाई लगनखेलमा मर्ज गरी व्यवस्थापनको सुरू गर्न सकिन्छ) र आवश्यकताअनुसार उपवितरण केन्द्रको व्यवस्था गर्ने ।

काठमाडौं जिल्लाका हकमा हालको क्षेत्रीय कार्यालयले सो जिम्मेवारी पूरा गरे हुन्छ । ग्राहक संख्या, महशुल संकलन, सेन्सेटिभ एरियालाई मध्यनजर गर्दै ९ तहभन्दा माथिको प्रमुख बनाउन नमिल्ने होइन कि? अन्यत्रको आधार पनि हेरौ न ।

महानगरपालिकाका हकमा अन्य देशका ठूला सहरमा भएको व्यवस्थालाई आधार मान्न सकिन्छ । स्थानीय निकायले विद्युत् वितरणमा सहकार्य गर्न सक्ने भएकाले सोबारे स्पष्ट नीतिगत मोडालिटी बनाउने ।

काठमाडौंका विभिन्न स्थानमा भएका नोलाइटलाई समन्वय गर्ने गरी रत्नपार्कमा एउटा नोलाइट कल सेन्टरको व्यवस्था गर्ने । विभिन्न ठाउँमा एरिया स्पेसिफिक भई नोलाइटका कर्मचारीलाई दुईवटा कोठा र पार्किङ्ग हुने गरी GPS सेवासहित गाडीको व्यवस्था गर्न सकिनेछ ।

सबै वितरण केन्द्रलाई इन्टरनेटमार्फत् कनेक्सन गरी डाटाबेस अद्यावधिक गर्ने व्यवस्थाबाट नोलाइट, सर्भर सञ्चालन, आय तथा अन्य फाँटका जनशक्ति न्युन गर्न सकिनेछ र सञ्चालन खर्च घटाउन सकिन्छ ।

(घ) केही फरक हिसाबमा जान आवश्यक विषयवस्तु

हामीले सेवा प्रदान गरेका छौं, मौजुदा स्रोत र साधनले जे सकिन्छ, सोहीअनुसार कार्य भएको पनि छ । यसैमा सुधार गर्ने एउटा विचार हो भने अर्को मोडालिटीमा यसलाई परिमार्जित गर्ने भन्ने पनि त हुन्छ । तसर्थ, केही तपसिलका विषयमा समेत छलफल हुनु मनासिब हुनेछ ।

१. कम्पनी मोडलका रूपमा वितरण प्रणालीलाई लैजाने सन्दर्भमा

नेपाल टेलिकमलाई कम्पनीको रूपमा लगे जस्तै गरी नेविप्रालाई पनि सोही मोडलमा कम्पनीमा लैजाने (टेलिकमलाई कम्पनी बनाउँदा ल्यान्डलाइन, मोबाइल, इन्टरनेट गरी छुट्याइएको भए कुनै फाइदा र कुनै घाटामा जानसक्ने हुँदा प्रगति हुन सक्थेन भन्ने अनुमान गर्न सकिन्छ) । सोहीअनुरूप नेविप्रालाई अहिले गरिएको कम्पनी मोडल कालान्तरमा गलत हुन्छ कि, कुनै फाइदामा जाने कुनै जहिले घाटामा, बहस/अध्ययन गर्न आवश्यक छ ।

सामुदायिक विद्युतीकरणको उपस्थितिलाई कम्पनी मोडल मान्ने हो भने पहिला लागतअनुसारको शुल्क उनीहरूसँग लिने व्यवस्था गरौं त, कतिले निरन्तर विद्युत् वितरणको कार्य गर्लान् र कतिले छोडलान्, अनुमान गर्न सकिन्छ ।

नेविप्राका पुराना विद्युतगृह, जसको उत्पादन खर्च १ रूपैयाँप्रति युनिट भन्दा कम छ, ती विद्युत् गृहका उपस्थितिले हामीले घाटा कम गरी फाइदामा जाँदैछौ । हाल आइपीपीलाई दिइएको विद्युत् खरिद दरलाई आधार मानी विद्युत् खरिद भएको अवस्था हो भनी अध्ययन गर्ने हो भने विद्युत् महसुल के कसरी बढ्छ, अध्ययन गर्ने (किनकि ती सबै भोलि कम्पनी नहोलान् भन्न सकिन्न) ।

एकीकृत बस्ती विकासको अवधारणा नभएको र २/४ घर भए पनि बत्ति/पानी पुर्‍याउनु पर्ने जिम्मेवारी हुने अवस्थामा सबै ठाउँमा सेवा दिन अधिक लागत पर्ने हुन्छ ।

२. प्रादेशिक संरचनामा विद्युत् वितरण कार्यलाई व्यवस्थित गर्ने सन्दर्भमा

हालको प्रादेशिक संरचनामा विद्युत् प्राधिकरणलाई लैजान संविधानमा भएको व्यवस्थालाई अनुशरण गर्नुपर्ने नै हुन्छ ।

यसका लागि विभिन्न ठाउँमा छलफल चलिरहेकाले विज्ञको सुझाव लिने, अन्यत्रको राम्रो प्राक्टिस अनुशरण गर्ने ।

३. हामी जस्तै अन्य देशबाट सिक्ने कुराका सन्दर्भमा

हाम्रो जस्तै अवस्थाबाट सुधार गर्दै गइरहेको भियतनामको

विद्युत् आपूर्ति र सो सम्बन्धमा भएको व्यवस्था हेरी कार्यान्वयन गर्ने ।

अझ राम्रोका लागि विभिन्न देशका मोडल अध्ययन गरौं र राम्रो एवं प्रयोग गर्न सकिने खालको लाई कार्यान्वयन गर्नेतर्फ पहल गरौं ।

सेवाशुल्कलाई न्यूनतम शुल्क भनी संशोधन गरी पठाइएजस्तो नगरेर थप अध्ययन गरी अन्य कुरा पनि सुधार गर्ने ।

४. विविध

देशको योजनालाई मनन् गरी विद्युत उत्पादन, प्रशारण तथा वितरणको व्यवस्थाका लागि Reliable System बनाउन पहिले स्पष्ट कार्ययोजना बनाउने ।

विद्युत् आयात निर्यात गर्न सहजताका लागि सार्क ग्रिडको अवधारणालाई अघि बढाउन सरकारलाई घच्घच्याउने ।

कुन देशको व्यवस्थालाई राम्रो मान्नलाई सबैको अध्ययन गर्न कम्तीमा ५ जनाको कमिटी बनाई १ महिना अध्ययन भ्रमणमा पठाउने, निचोड राम्रै आउला ।

(ङ) उपसंहार

यस लेखमा संस्थागत सुधारका लागि मात्र एउटा पाटोलाई समाई अन्य केहीमा अध्ययन बहस गर्न आवश्यक विषयवस्तुमा मात्र उल्लेख गरेको छु । साँच्चै संस्थालाई अहिले भन्दा अझ सबल सक्षम बनाउन सक्ने धेरै ठाउँ छन्, आउनुहोस्, हातेमालो गरौं ने.वि.प्रा.लाई भोलिका दिनमा सशक्त बनाई राम्रो बनाऔं : नेपालमा विद्युत वितरण एवं ग्राहक सेवा !!!

विद्युतको आन्तरिक खपतबाट देश विकास

अम्बिकेशकुमार झा
उपप्रबन्धक, त्रिशुली ३ ए जलविद्युत आयोजना, नेपाल विद्युत प्राधिकरण

देशको विकास गर्न मुख्य रूपमा आफ्नो स्रोतसाधन र उद्देश्यलाई दृष्टिगत गरी क्षेत्रको पहिचान गरी लगानीलाई प्राथमिकीकरण गर्नुपर्ने हुन्छ । छिटो र राम्रो तवरले विकास गर्नका लागि स्रोतसाधन त्यहाँ लगाउनुपर्ने हुन्छ, जहाँबाट Guaranteed प्रतिफल प्राप्त होस् । यसका लागि केही कुरामा ध्यान दिनु जरूरी हुन्छ । जस्तो उदाहरणका लागि ऊर्जा क्षेत्रलाई लिऊँ : अहिले देशैभरि व्यापक चर्चा परिचर्चा भइरहेको क्षेत्र हो यो । देशका आम जनतादेखि कर्मचारी, नेतासम्म सबै यसमा एकमत छन् कि नेपालको विकास गर्नका लागि ऊर्जाक्षेत्र खास गरेर जलविद्युत्मा लगानी अपरिहार्य छ । यी कुरा सही हुन् तर त्यो भन्दा पहिले केही कुरामा विचार गर्नुपर्ने देखिन्छ ।

आजको परिवेशमा ऊर्जा एक अत्यावश्यक उत्पादन हो । ऊर्जाको विकासविना आज कुनै पनि क्षेत्रको विकास असम्भव छ । नेपालमा ऊर्जा खास गरेर जलविद्युत्को प्रचुर सम्भावना रहेको छ । डा. हरिमान श्रेष्ठले सन् १९६६ मा नेपालको कूल जलविद्युत् ऊर्जाको सम्भाव्यता ८३,००० मेगावाट भनी उल्लेख गरेका थिए । सन् १९११ मा ५०० किलोवाट क्षमताको पहिलो जलविद्युत् केन्द्रको रूपमा फर्पिङ जलविद्युत् केन्द्रको निर्माण भएयताको एक सय सात वर्षमा नेपालले जलविद्युत्बारे धेरै कुरा गऱ्यो तर काम भने खासै भएन । ८३,००० मे.वा.मध्ये हामीले अहिलेसम्म मुश्किलले १००० मे.वा. पनि विकास गर्न नसकेको अवस्था छ । तर पछिल्लो केही वर्षयता परिदृश्य फेरिएको छ । जलविद्युत् प्रत्येक सर्वसाधारणदेखि बुद्धिजीवी, पत्रकार, सरकारी, निजी सबै क्षेत्रको ध्यानाकर्षण भएको छ । फलस्वरूप जलविद्युत् क्षेत्रले फड्को मार्ने बेला आएको भान हुन्छ । यस वर्षको ऊर्जा क्षेत्रमा छुट्याइएको करिब ८३ अरब बजेटले समेत यस कुराको पुष्टि गर्न खोजेको देखिन्छ ।

ऊर्जा उत्पादनको मुख्य लक्ष्य ऊर्जाको मागसँग यसको तालमेल मिलाई सर्वसुलभ तवरले यसको आपूर्ति सम्भव तुल्याउनु हो अर्थात् ऊर्जाको मागलाई पूर्ति गर्नु हो । तर यो त्यति सजिलो विषय होइन किनभने एकातिर माग स्थिर रहँदैन भने अर्कोतिर उत्पादन पनि सधैं एकैनासले हुने अवस्था छैन । एकातिर नेपालमा विद्युत्को माग वर्षायाममा कम र हिउँदमा बढी छ भने अर्कोतिर यसको उत्पादनको अवस्था ठीक उल्टो छ अर्थात् विद्युत्को उत्पादन वर्षायाममा बढी र हिउँदमा कम हुने गरेको छ । गत वर्षको तथ्यांक हेर्ने हो भने हिउँदको अधिकतम माग १४४४.१ मे.वा. रहेको अवस्थामा उत्पादन करिब ७०० मे.वा.को हाराहारीमा रहेको देखिन्छ । यसको मुख्य कारण उत्पादनको रूपमा रहेका नदी बहावमा आधारित विद्युत् आयोजना हुन् । वर्ष २०१७ को कुल जडित क्षमता ९७२.५ मे.वा.ले वर्षायाममा मुश्किलले माग धान्ने अवस्था रहे पनि हिउँदमा उत्पादन करिब जडित क्षमताको दुई तिहाइ मात्र हुँदा र माग अत्यधिक हुने हुँदा आयात गरेर आपूर्ति गर्नुपर्ने अवस्था वा लोडसेडिङ गर्नुपर्ने अवस्था आएको हो । तर अबको केही वर्षमा यो अवस्थामा व्यापक परिवर्तन हुने देखिन्छ ।

आगामी एक वर्षभित्र निर्माण सम्पन्न भई उत्पादन थाल्ने योजनालाई दृष्टिगत गर्ने हो भने सन् २०१९ को अन्त्यसम्ममा राष्ट्रिय ग्रिडमा ८३०.१ मे.वा. विद्युत् थप हुने देखिन्छ अर्थात्

तालिका १

आगामी वर्ष सन् २०१९ भित्र उत्पादन सुरू हुने आयोजना

NEA / Subsisiary Company Projects at Final Stages of Construction

S. No.	Under Construction Project	Capacity
1	Upper Tamakoshi Hydropower Project	456
2	Chameliya HEP	30
3	Kulekhani III HEP	14
4	Upper Trishuli 3A HEP	60
5	Upper Sanjen	14.6
6	Sanjen	42.5
7	Rasuwa Gadhi	111
8	Madhya Bhote Koshi	102
	Total (MW)	830.1

सन् २०१९ को अन्त्यसम्ममा कूल जडित क्षमता २२७४.२ मे.वा. हुन आउँछ । वार्षिक १० प्रतिशत मागमा वृद्धिका दरले २०१९ को अन्त्यमा हुने उच्च माग करिब १७५० मे.वा. हो । जाडोयाममा उत्पादनको स्तर नदीबहावमा आधारित जलविद्युत् क्षमताको दुईतिहाइ लिने हो भने त्यतिखेरको उत्पादन करिब १५५० मे.वा. हुन आउँछ । जलाशययुक्त कुलेखानी र Peaking क्षमताका आयोजनालाई समेत विचार गर्दा त्यतिखेर देशको आन्तरिक उत्पादनले जाडोयामको उच्चतम मागलाई सम्बोधन गर्न सक्ने देखिन्छ । तर वर्षायाममा भने यो विजुली हामीलाई चाहिनेभन्दा बढी हुन् जान्छ । यसलाई सम्बोधन गर्न छिमेकी मुलुकलाई निर्यात गर्ने वा आन्तरिक खपत बढाउने उपाय हुन सक्छन् ।

अझ निर्माणाधीन र निकट भविष्यमा निर्माण सम्पन्न हुने आयोजनालाई हेर्ने हो भने अबको पाँच वर्षमा देशको कुल जडित क्षमता करिब ४५०० मे.वा. पुग्ने देखिन्छ । विद्युतीय मागमा अहिलेकै वार्षिक सरदर दश प्रतिशतका दरले वृद्धि हुने हो भने यो सन् २०२३ सम्ममा करिब २५६० मे.वा. पुगेर मागको तुलनामा झण्डै २००० मे.वा. बढी हुन् जान्छ अर्थात् उत्पादित विद्युतको व्यवस्थापन छुट्टै ढंगले गर्नु आवश्यक देखिइसकेको अवस्था छ ।

ऊर्जा व्यवस्थापनका लागि मुख्य दुईवटा आधार हुन सक्छन् : एक, बढी भएको उत्पादित ऊर्जा विदेशमा निर्यात गर्ने र दुई, स्वदेशमै यसको खपत गर्ने व्यवस्था मिलाउने ।

यहाँ आएर हामीले सुन्दै आएको विद्युतलाई विदेशमा बेचेर धनी हुने अवधारणा फलिफाप हुने हो कि होइन, विचार गर्नुपर्ने देखिन्छ । बिक्री गर्नका लागि मुख्यतः बजारको उपस्थिति र खरिद बिक्री मूल्य निर्णायक हुन जान्छ । जहाँसम्म बजारको उपस्थितिको कुरा छ, भारत एउटा ठुलो बजार हो । भारतमा जहिले पनि विद्युत् आपूर्तिको तुलनामा त्यसको माग बढी हुने गरेको तथ्य छ । त्यसैले यहाँ खरिद बिक्री मूल्यबारे एकचोटि विचार गरौँ । ऊर्जा उत्पादनको प्रतियुनिट लागत र Cost per unit कति अनि यसरी उत्पादित ऊर्जा बेचेर हामी कति कमाउन सक्छौं, यसको लेखाजोखा जरूरी हुन आउँछ ।

जस्तो अहिले एउटा उदाहरणका लागि लिउँ । विद्युत्को सरदर, सालाखाला मूल्य प्रतियुनिट नेपालमा नौ रूपैयाँ पचासी पैसा छ, जुन कि सम्भवतः दक्षिण एसियाकै महँगो मध्ये हो । भारतमा यसको सालाखाला मूल्य भारतीय चार रूपैयाँको हाराहारीमा छ, जुन कि नेपाली छ रूपैयाँ चालीस पैसा जति पर्‍यो ।

यदि हामीले भारतलाई बेच्ने हो भने हाम्राले ऊर्जाको बिक्री मूल्य घटाउनु पर्‍यो । हामी आफैंले ऊर्जा सालाखाला दस रूपैयाँमा किनिरहेका छौं भने भारतीयलाई त्यो भन्दा घटीमा कसरी बेच्ने ? लागत नै जब उठ्दैन भने त्यस्तो व्यापार कसरी नाफामूलक हुन्छ ? भारतमा सालाखाला ऊर्जाको जुन बिक्रीदर छ, त्योभन्दा बढीमा हामीले बेच्न खोज्यौं भने

तालिका २

विद्युतको प्रतियुनिट बिक्री दर विश्लेषण

Average Electrical Energy Price Calculation

Particulars	2015			2016			2017		
	GWh	Million NRs.	Per Unit	GWh	Million NRs.	Per Unit	GWh	Million NRs.	Per Unit
Domestic	1679.35	12706.55	7.57	1796.78	14833.65	8.26	2150.21	19693.53	9.16
Non-Commercial	130.53	1644.45	12.60	134.37	1995.1	14.85	163.77	2626.01	16.03
Commercial	300.25	3735.00	12.44	286.48	3788.76	13.23	352.37	5121.75	14.54
Industrial	1352.15	11064.84	8.18	1205.69	10182.32	8.45	1735.05	16759.77	9.66
Water Supply & Irrigation	86.56	480.71	5.55	100.42	525.3	5.23	113	711.27	6.29
Street Light	76.48	629.65	8.23	73.88	602.37	8.15	78.9	686.83	8.71
Temporary Supply	1.52	27.39	18.02	2.1	29.25	13.93	3.1	54.11	17.45
Transport	6.24	41.44	6.64	6.09	39.74	6.53	6.6	45.86	6.95
Temple	4.85	29.17	6.01	5.53	33.92	6.13	7.4	47.21	6.38
Non-Domestic							45.46	708.39	15.58
Entertainment							0.97	17.43	17.97
Community Sales	102.62	400.12	3.90	104.48	411.5	3.94	117.01	560.91	4.79
Total (Internal Sales)	3740.54	30759.31	8.22	3715.82	32441.91	8.73	4773.84	47033.07	9.85
Bulk Supply (India)	3.17	39.36	12.42	3.15	32.07	10.18	2.69	28.74	10.68
Grand Total	3743.71	30798.67	8.23	3718.97	32473.98	8.73	4776.53	47061.81	9.85

**Source NEA Annual Report 2017*

उसले त्यो किन्दैन । व्यापार त नाफाका लागि हो ।

ऊर्जा भनेको संसारमै सस्तो चिज हो । तर हाम्रो यहाँ त ऊर्जा उत्पादनको वर्तमान लागत हेर्ने हो भने यो महँगो छ र व्यापारका लागि उपयुक्त छैन । हामीले जलविद्युत् उत्पादन गर्दाखेरि अरू कतिपय देशमा यसको जुन बिक्रीमूल्य छ, हाम्रोमा त उत्पादनको लागत नै त्यो भन्दा बढी हुन्छ । यसले गर्दा ऊर्जा क्षेत्रको मात्रै विकास गरेर अहिलेकै अवस्थामा त्यो बेचेर हामी धनी बन्छौं भन्दा सायद त्यो सही नहोला । यसमा व्यापक अनुसन्धान, सोच र सुधारको आवश्यकता छ । ऊर्जा उत्पादनको लागत उल्लेख्य रूपमा घटाउन सकेको खण्डमा हो, त्यसपछि सायद केही हदसम्म यो सम्भव होला । तर अहिलेकै अवस्थामा चाहिँ पक्कै होइन । त्यसैले ऊर्जालाई विदेशमा बिक्री गरेर भन्दा पनि आफ्नै देशमा उद्योगधन्दा, कलकारखाना, पारवहन आदि क्षेत्रमा उपयोग गरेर फाइदा बढाउनेतर्फ सोच राख्नु बढी फाइदाजनक हुन्छ । त्यसैले ऊर्जा उत्पादनलाई अरू क्षेत्रसँग 'टाइअप' गरेर ऊर्जा उत्पादनको लागत सेयर गरेर जानु उपयुक्त हुन्छ । यसका लागि निम्न क्षेत्रको पहिचान र विकास योजना तुरुन्त तयार गरेर अगाडि बढ्नु उपयुक्त हुने देखिन्छ ।

ऊर्जालाई उद्योगसँग Tie up गरी Integrated Development Plan तयार पार्ने

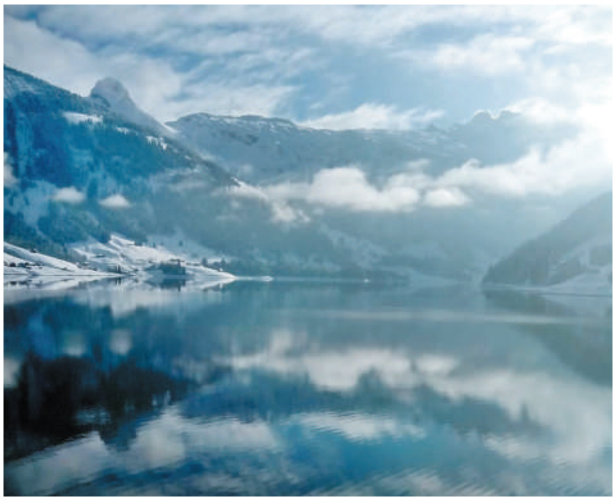
ऊर्जा आफैंमा उपभोग्य वस्तुसरह हो र हामीले यसको उपभोग जीवन सरल बनाउन जस्तो बत्ति बाल्न, पंखा चलाउन, हिटर बाल्न आदिका लागि गर्छौं तर साथसाथै यो अन्य काम पूरा गर्न अत्यावश्यक स्रोतसाधन पनि हो । खास गरेर उद्योग चलाउन, विद्युतीय सवारी चलाउन, खाना पकाउन आदि । उद्योगमा ऊर्जाको रूपमा विद्युत्को प्रयोग र सँगसँगै अरू पनि विभिन्न सामग्री प्रयोग गरेपछि हामीले वस्तु निर्माण गर्दछौं, जसको मूल्य बढी हुन्छ । कुनै पनि कच्चा पदार्थको भन्दा Finished Product (अन्तिम उत्पादित वस्तु)को मूल्य जहिले पनि बढी हुन्छ । जस्तो आलुको मूल्यभन्दा आलु चिप्सको मूल्य बढी हुन्छ । त्यही भएर जुन देशले राम्रो कच्चा पदार्थ बेच्छ, त्यसको तुलनामा तयारी सामान बनाएर बेच्ने देश बढी धनी हुन्छन् । उदाहरणका लागि जापान, जापानसँग कच्चापदार्थ थोरै छ, तर उसले अन्य देशबाट कच्चापदार्थ आयात गरेर त्यसलाई तयारी सामानको रूपमा रूपान्तरित गरेर महँगोमा बेच्छ, जसले गर्दा जापानको प्रतिव्यक्ति आय कच्चा पदार्थ बेच्ने देशको तुलनामा धेरै माथि छ । यो एउटा उदाहरण मात्रै हो । दक्षिण कोरियालाई अर्को उदाहरणका रूपमा लिन सकिन्छ । यस्ता थुप्रै उदाहरण छन् । हामीले ऊर्जालाई यदि Input Resource को रूपमा मान्ने हो भने ऊर्जालाई उद्योगसँग Tie up गरी Integrated Development Plan तयार गरेर अगाडि बढ्न जरूरी छ ।

ऊर्जा उत्पादनलाई निकासीजन्य भन्दा पनि आन्तरिक खपतका लागि विकास गर्नु आजको आवश्यकता हो । त्यसमा पनि ऊर्जाको Input बाट यसमा Value Add हुने गरी विकासको परिकल्पना जरूरी छ । यसका लागि ऊर्जा उत्पादन र देशमा औद्योगिक क्रान्तिको वातावरण सँगसँगै बन्नु जरूरी छ । ऊर्जा र उद्योग सँगसँगै विकास हुने गरी नीतिनियम बनाएर अनि यसका लागि उचित वातावरण तयार पारेर अगाडि बढ्नु उपयुक्त हुन्छ अर्थात् उद्योगका लागि सुरक्षित वातावरण, लगानीमैत्री वातावरण बनाउने र सँगसँगै ऊर्जा क्षेत्रलाई प्राथमिकतामा राखेर अगाडि बढ्ने । यसले गर्दा छोटो समयमा उद्योगले प्रतिफल दिन्छ र त्यो अरू क्षेत्रमा लगानीको लागि पनि योग्य हुन्छ । उदाहरणका लागि थुप्रै औद्योगिक क्षेत्रको अवधारणा र सँगसँगै ठूला उद्योगका लागि Multi National कम्पनीसँगको सहकार्यता । त्यस्तै चिनी मिलसँग विद्युत् आदानप्रदान र किनबेच सम्झौता । अधिकांश चिनी मिलले कार्तिक महिनाबाट उत्पादन थालेर चैत्र अन्त्यसम्ममा उद्योग बन्द गर्ने गर्छन् । यतिखेर उद्योगमा चाहिने भन्दा बढी विद्युत्को उत्पादन हुन्छ र संयोगले नेपालमा विद्युत्को खपत बढी हुने अनि उत्पादन कम हुने समय पनि यही हो । अर्थात् चिनी मिलसँगको सहकार्यले आवश्यकता परेको बेला ऊर्जा सन्तुलन राख्न मद्दत पुऱ्याउने हुन्छ ।

ऊर्जा र पर्यटन पूर्वाधारको सँगसँगै विकास

प्रकृतिले नेपाललाई बरदानस्वरूप पर्यटन विकासका थुप्रै सम्भावना दिएको छ । उद्योगधन्दाको सँगसँगै पर्यटन पूर्वाधार विकासमा पनि हामीले लगानी गर्न सक्यौं, त्यसलाई पनि सँगसँगै प्राथमिकतामा राख्न सक्यौं भने त्यसले पनि छोटो समयमा देशलाई विश्वमा चिनाउने र देशलाई धनि बनाउनेतर्फ योगदान दिन सक्छ । पर्यटन विकासका लागि खास गरेर स्तरीय होटल, पारवहन आदि आवश्यक पूर्वाधार हुन् । यसमा ऊर्जाको समुचित उपयोग हुन्छ र यसबाट प्रतिफल पनि सोचेभन्दा बढी हुन्छ । पर्यटन पूर्वाधारको विकासको रूपमा बहुउद्देश्यीय आयोजना अगाडि बढाउन सकिन्छ, जसले देशको सौन्दर्यता बढाउनुका साथसाथै अन्य क्षेत्रलाई पनि टेवा पुऱ्याउन सकोस् ।

उदाहरणका लागि उत्तरगंगालाई लिउँ । उत्तरगंगा ढोरपाटन क्षेत्रको एउटा प्रमुख जलविद्युत् आयोजना हो । त्यसैमा Multi purpose अर्थात् बहुउद्देश्य राखेर यदि हामीले उत्तरगंगा आयोजनालाई पर्यटन क्षेत्रसँग पनि Integrate गरेर यदि ढोरपाटन क्षेत्रमा एउटा ठूलो ताल बनाउने, त्यो तालको चारैतिर रिङरोड बनाउने, त्यो रिङरोडको माथि होटेल, रेस्टुरेन्ट, आवासगृह, रिसोर्ट एउटा निश्चित मापदण्ड तोकेर, नक्सा डिजाइन तोकेर सरकार आफैंले बनाइदिने वा निजी क्षेत्रसँग साझेदारी गरेर मापदण्ड तोकेर बनाउन लगाउने, ढोरपाटनमा बनेको ठूलो तालमा कश्मिरको डुंगा जस्तै



House Boat राखेर पर्यटकलाई आकर्षित गर्ने किनभने त्यो क्षेत्र स्वीटजरल्याण्डको कुनै पनि अति नै राम्रो पर्यटकीय गन्तव्यभन्दा धेरै राम्रो छ। चारैतिर Pine Tree भएका हरियाली उत्तरपट्टिको हिमाल, जाडो महिनामा त अझ चारैतिर हिमाल जस्तै देखिन्छ। अझ ढोरपाटनको ताल त संभवतः जाडो महिनामा पूरै जमेर Ice Skating का लागि उपयुक्त हुन सक्छ। यसले विश्वको अन्य पर्यटकका साथसाथै सबैभन्दा ठूलो संख्यामा खास गरेर गर्मी महिनामा भारतीय र चिनियाँ पर्यटकलाई तान्ने हुन्छ। हजारौं, लाखौंको संख्यामा त्यहाँ भारतीय र चिनियाँ पर्यटक भित्रिन्छन् र यसबाट प्रशस्त विदेशी मुद्राआर्जन गर्न सकिन्छ। यो एउटा प्रतिनिधि योजना मात्र हो। यस्ता थुप्रै Multi-purpose आयोजनाको सम्भाव्यता यहाँ रहेको छ, जुन कि देश विकासमा कोशेढुंगा बन्न सक्ने सम्भावना छ अर्थात् जलविद्युत् र पर्यटन सँगसँगै, बहुउद्देश्यीय आयोजनाको रूपमा अगाडि बढाउने।

जलविद्युतसँगै यातायात र पारवहनको विकास

युरोपमा सन् २०३० पछि खनिज पदार्थमा आधारित यातायातको व्यवस्था अन्त्य हुँदैछ। त्यहाँ ठाउँठाउँमा विद्युत् रिचार्ज गर्ने स्टेसन धमाधम बनाइँदैछन्। नेपालमा पनि आफूले उत्पादन गरेको ऊर्जा आफैंले खपत गर्ने गरी विद्युतीय सवारी साधनको Network बनाउन जरूरी छ। सर्वप्रथम मुख्य राजमार्ग र पछि अन्य सहायक राजमार्गमा समेत विद्युतीय सवारी साधन चलाउने गरी अहिलेबाट Infrastructure बनाउँदै लैजाने, जसले भविष्यमा ठूला जलविद्युत् आयोजनाबाट उत्पादित विजुली उपयोग गर्न सकियोस्। त्यस्तै पूर्वपश्चिम, उत्तरदक्षिण विद्युतीय रेलमार्गको विकासलाई प्राथमिकतासाथ अगाडि बढाउने। मित्रराष्ट्र खास गरेर चीन र भारतसँग रेल मार्गको सम्झौता गर्दा त्यसलाई आवश्यक पर्ने विद्युतका लागि Dedicated जलविद्युत् आयोजना किटान गर्ने र त्यसको पनि सँगै विकास गर्ने। यसले गर्दा ऊर्जा र यातायातको सँगै विकास हुनुका साथै परनिर्भरताको समस्या पनि समाधान हुन सम्भव छ।

ऊर्जा र कृषिको औद्योगिकरण

नेपाल कृषिप्रधान देश हो। विगतमा कृषिउपज निर्यात गरी रहेको नेपाल आज आयात गर्ने देशमा परिणत भएको छ। कृषिउपजका विभिन्न क्षेत्रमा औद्योगिकरण गर्न सकिएमा स्वरोजगार, आन्तरिक मागको आपूर्ति र निर्यात समेत प्रवर्द्धन भई विद्युत्को आन्तरिक खपतले राष्ट्रिय अर्थतन्त्रमा सकारात्मक योगदान पुग्ने देखिन्छ। कृषि उपकरण तयार गर्ने उद्योग, मल विउविजन तथा उत्पादन तथा सरक्षण, शितभण्डार, कृषिबाट उत्पादन हुने उत्पादनका क्षेत्रमा ठूलो परिमाणमा विद्युत खपत गर्न सकिन्छ।

ऊर्जा र सेवा क्षेत्रको औद्योगिकरण

नेपाल वातावरणिय दृष्टिले असाध्यै सुन्दर देश हो। यहाँ हावापानीका दृष्टिले उपयुक्त भनिएका क्षेत्रमा मेडिकल कलेज, अस्पताल स्थापना गरी विदेशी विद्यार्थी र विरामीका लागि उत्तम गन्तव्य हुन सक्छ। त्यस्तै सूचना प्रविधिलगायत अन्य विषयका विश्वविद्यालय, तालिम वा सम्मेलन केन्द्र बनाई सेवा क्षेत्रको औद्योगिकरण गरिएमा ऊर्जाको आन्तरिक खपत गरी value addition गरिन्छ।

अन्तरदेशीय विद्युत आदानप्रदान र व्यापार

विश्वका कतिपय देशमा विद्युतको आदानप्रदान र व्यापार अति नै सफलतापूर्वक भइरहेका छन्। खास गरेर Scandinavian देश जस्तो नर्वे, स्वीडेन, डेनमार्क आदिमा यो अति नै सफल छ। Tear Tariff System को रूपमा एक देशलाई बढी भएको विद्युत अर्को छिमेकी देशलाई दिने र आफूलाई आवश्यक परेको बेला उताबाट लिने (एक किसिमको इनर्जी बैंकिङको व्यवस्था), छिमेकमा विद्युतको माग उच्च भएको बेला महँगो मूल्यमा बेच्ने र उता सस्तो भएको बेला आफूले किन्ने, Real Time मा आधारित विद्युत्को व्यापार गर्ने आदि जस्ता कार्यले छिमेकी देशलाई एकआपसमा बाँध्नुको साथै सहयोग र साझेदारीको विकास हुन जान्छ। दक्षिण एसिया क्षेत्रमा पनि यस्तो व्यवस्था उपयुक्त हुने देखिन्छ। उदाहरणका लागि नेपालमा नदी प्रवाहमा आधारित जलविद्युतको विकासले गर्मी र वर्षातको महिनामा उत्पादन उच्च हुन जान्छ तर खपत त्यति हुँदैन। अर्कोतिर भारत र बंगलादेशमा विद्युत्को माग गर्मीमा अत्यधिक रहन्छ। यसले गर्दा नेपालले गर्मीमा विद्युत् निर्यात गर्ने सम्भावना हुन्छ। यसको ठीक विपरीत जाडो मौसममा नेपालका नदीनाला सुक्दै जाँदा विद्युत् उत्पादनमा निकै कमि हुन जान्छ। तर त्यही बखत माग भने उच्च हुन जान्छ। छिमेकी देशमा विद्युत्को मागमा कमी हुने यस समयमा विद्युत्को आयात गर्न सकिने देखिन्छ अर्थात छिमेकी देशबीच विद्युत् आदानप्रदान, Energy Banking, Tear Tariff System अन्तर्गत साझेदारी बढाउने !

नेपालको ऊर्जा दक्षता कार्यक्रम चुनौती र अवसर

सागरमणि झवाली

सहायक प्रबन्धक, ऊर्जा दक्षता तथा चुहावट नियन्त्रण विभाग, नेपाल विद्युत प्राधिकरण

१. पृष्ठभूमि

यो विषयमा लेख्नुअगाडि बजारबाट केही 'लिड' बल्व किनें । नेपाल विद्युत प्राधिकरण केन्द्रीय कार्यालयमा जोडिएका केही 'लिड बल्व झिकियो । ४०० भोल्टसम्मका विद्युतीय उपकरण सम्बन्धित साना ठूला व्यवसायिक र औद्योगिक संस्थाको इनर्जी अडिट गर्नसक्ने उपकरण बजारमा उपलब्ध छन् । तिनैमध्येको एउटा भोल्टक्राफ्टमा यी बल्वका विद्युतीय विषेशता नापियो । हाम्रो अनुमानलाई सही सावित गर्दै केही नाम चलेका कम्पनीका बल्व (चिम) बाहेक धेरैले आफैंले लेखेको रेटिङभन्दा घटी निकै कमजोर गुणस्तरका सामग्री बेचेका छन् ।

हामीले लिएका १० प्रकारका बल्वमध्ये जम्मा तीनवटा बल्वले भनेको गुणस्तर वरिपरि काम गरे । धेरै त भनेको क्षमता भन्दा ३० प्रतिशतसम्म तलका छन् । सबैभन्दा दु:खको कुरा यी बल्वको पावर फ्याक्टर ०.६ भन्दा पनि तल छ । यसको अर्थ यिनले उत्तिकै उज्यालो फाल्न ४० प्रतिशत बढीसम्म बिजुली खपत गराएका छन् । यसअर्थमा बिजुली कम खपत गर्ने भनेर लिड बल्व किनेका उपभोक्ता ठगिएका छन् । सामान सस्तो र प्रतिस्पर्धी बनाउन गुणस्तरमा सम्झौता गरेपछि यी बल्व पक्कै लामो आयु हुने डिजाइनमा बनाइएका होइनन् ।

बजारमा सबैको आँखा पुगेको, राष्ट्रिय स्तरमा लामो समयसम्मचर्चा चलेको, उपभोक्तामाझ धेरै परिमाणमा चल्ने लिड बल्वको विद्युतीय गुणस्तरबारे चर्चा गरेपछि अरू विद्युतीय सामग्रीबारे खासै उल्लेख गरिरहनु नपर्ला । किनभने यसको गुणस्तर मापन गरी बजार प्रवेश गर्न दिने/नदिने कुनै सरकारी नीति र संयन्त्र छैन । खासमा यस्ता गुणस्तरहीन विद्युतीय सामग्री प्रयोग हुनाले विद्युत वितरक कम्पनीको रूपमा नेपाल विद्युत प्राधिकरणको विद्युत क्षति, उपभोक्ताको अनावश्यक पैसा खर्च र समग्र विद्युतीय सामग्रीको बजार विद्युतीय डम्पिङसाइटमा फेरिंदै गरेको अवस्थाको समग्र राष्ट्रिय अर्थतन्त्रमा परेको नकारात्मक प्रभावको लेखा-जोखा यो सानो आलेखमा गर्न सम्भव छैन । विद्युत् क्षेत्रमै काम गर्ने धेरैजनाले ऊर्जा दक्षता कार्यक्रम लागू हुँदा नेपाल विद्युत प्राधिकरणले कम बिजुली बेच्ने अवस्था सृजना हुन्छ, जसले नेपाल विद्युत प्राधिकरणको व्यापार कम भई संस्थाको आम्दानी नै कम हुन्छ भनेर तर्क गर्नुभएको छ । पृथ्वीको दीर्घकालीन पर्यावरणका लागि संयुक्त राष्ट्रसंघकै एउटा कार्यसूची बृहत् ऊर्जा दक्षता कार्यक्रम रहेको अवस्थामा हाम्रा सोचाइ यस्ता निम्छरो बन्नुमा पक्कै यो विषय राष्ट्रिय प्राथमिकतामा नपरेर हो भन्ने स्पष्ट बुझ्न सकिन्छ ।

एक्काइसौं शताब्दीको एउटा निकै महत्वको विकास चुनौती भनेको तत्कालीन स्रोतबाटै ऊर्जा खपतको बढ्दो मागलाई पूरा गर्दै सन् २०५० सम्म नौ खर्ब पुग्ने विश्व जनसंख्यालाई यसपछिको पनि युगौंयुगसम्म पुग्ने गरी स्रोत व्यवस्थापन गर्नु हो । त्यसैले पनि ऊर्जा दक्षतालाई संसारभर बढ्दो ऊर्जाको मूल्य घटाउने, बढ्दो वातावरणीय समस्यालाई व्यवस्थापन गर्ने, ऊर्जा सुरक्षा बढाउने र समग्रमा खपतमा दक्षता बढाई ऊर्जा उत्पादनमै कम गरी भविष्यका चुनौतीलाई सम्बोधन गर्ने निकै महत्वको नवीनतम कार्यका रूपमा लिइन्छ । त्यसकारण अहिले करिब-करिब सवैजसो ऊर्जा खपत गर्ने उपकरणको डिजाइनको पहिलो शर्त नै कति कम ऊर्जा

खपत गरेर कति बढी कार्य गर्न सक्छ भन्ने हो । यसैले पनि ऊर्जा दक्षता आफैंमा हामीले संयुक्त रूपमा प्रयोग गर्दै आएको पृथ्वीमा आउने पुस्तालाई कस्तो बनाएर छोड्दैछौं भन्ने कुरासँग प्रत्यक्ष रूपमा जोडिएको छ ।

ऊर्जा प्रयोगबारे नेपालका केही तथ्यगत कुरा

नेपालको प्रतिव्यक्ति ऊर्जा खपत संसारमै तुलनात्मक रूपमा कम छ । संसारभरका तथ्याङ्क हेर्दा प्रतिव्यक्ति ऊर्जा खपत बढी भएका देशको मानवविकास सूचकाङ्क राम्रो छ । प्रतिव्यक्ति ऊर्जा खपत कम भएको देशको सूचकाङ्क निकै कमजोर छ । त्यसमाथि स्वच्छ ऊर्जामा पहुँच कति छ ? भन्ने कुराले देशको समग्र विकास र आर्थिक सूचकाङ्कमा फरक पार्दछ । हाल नेपालको वार्षिक प्रतिव्यक्ति विद्युत खपत १३९ यूनिट हो (वर्ल्ड बैंक, २०१८) । यो तथ्यांक चरम गरिबीका केही अफ्रिकी देशको बराबर हो । त्यसमाथि नेपालमा जम्मा प्रयोग हुने ऊर्जाको ८० प्रतिशत दाउरा वा गुइँठाबाट प्राप्त हुन्छ । व्यापारिक ऊर्जातर्फ पेट्रोलियम पदार्थ पूरै आयातीत हो भने विद्युत् पनि करिब ६ महिना आधाआधी त भारतबाट आयात हुन्छ । हालसम्म करिब ७४ प्रतिशत जनसंख्यामा राष्ट्रिय प्रशारण लाइन पुगेको छ (IEA, 2018) । यी सबै तथ्यांकले नेपालको ऊर्जाक्षेत्र गरिब एवं कमजोर ऊर्जा सुरक्षा, आयातमा पर-निर्भरता, ऊर्जा पहुँचमा अपर्याप्तता आदि देखाउँछन् । सबैखाले ऊर्जा जोडेर पनि प्रतिव्यक्ति ऊर्जा आपूर्ति ०.४१ टन तेल बराबर मात्र भएको देशमा ऊर्जा दक्षताको कार्यक्रमको अर्थ के हुन सक्छ र ? धेरैले प्रश्न गर्ने गरेका छन् ।

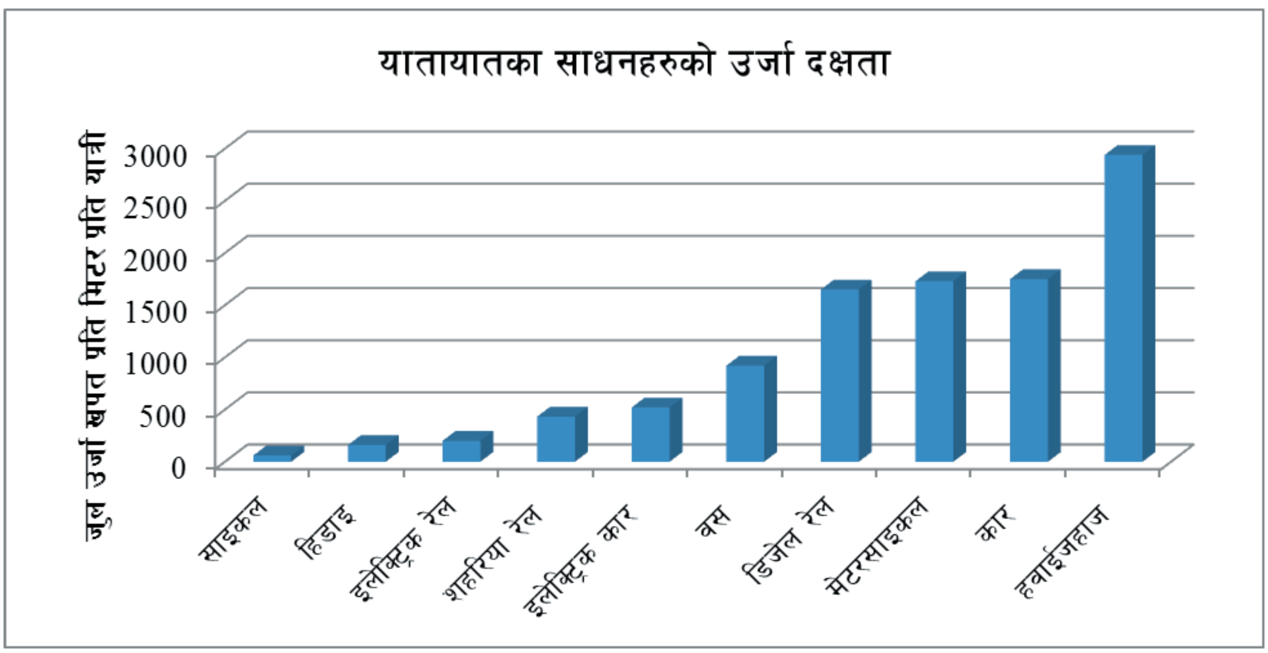
अर्कोतर्फ नेपालमा प्रति एक हजार डलर ग्राहस्थ उत्पादनका लागि १.०२ टन तेल बराबर ऊर्जा खपत भएको छ । यो तथ्यांक भारत, चीन र एसियाको औसत क्रमशः ०.५६,०.६० र ०.४७ टन तेलबराबर छ । अझै विश्वभरिको औसतसँग तुलना गर्दा नेपालले एक हजार डलर बराबरको ग्राहस्थ उत्पादनमा चार दोब्बर ऊर्जा खपत गर्दछ । यही तथ्यांकले नै हाम्रो ऊर्जा प्रयोगको संस्कृति कस्तो छ भन्ने प्रस्ट पार्दछ । हामीले यति नै ऊर्जाको प्रयोग गरेर पनि कम्तीमा आजको मितिको दोब्बर कूल ग्राहस्थ उत्पादन गर्न सक्छौं । यस्ताखाले कार्यक्रमले समग्र अर्थतन्त्रमा पार्ने प्रभाव हेर्ने हो भने नेपालमा ऊर्जा दक्षता कार्यक्रम निकै ठूलो अवसर भएको क्षेत्र हो ।

ऊर्जा दक्षता कार्यक्रमको कार्यक्षेत्र

सामान्य भाषामा भन्दा उक्त परिमाणको काम गुणस्तरमा कमी नल्याई पहिलेको अवस्था भन्दा कम ऊर्जा खपत गरी सम्पन्न गर्ने कला नै ऊर्जा दक्षता हो । एउटा डेक्चीमा दुई माना चामल पाक्न जति दाउरा लाग्छ, त्यति नै चामल एउटा प्रेसरकुकरमा पकाउँदा निकै कम दाउरामा सम्भव हुन्छ । अझै भान्सेको समय पनि बचत हुन्छ र निकै कम दाउराको खपतमा भात पकाउन सकिन्छ । थोरै खाए बल धेरै खाए मल भने झैं ऊर्जा दक्षताले 'ऊर्जा त्यति मात्र प्रयोग गर, जत्ति आवश्यक छ' भनेर सिकाउँछ । जस्तो, नहेरेको बेला टि.भी. बन्द गर्नु, दाउराले खाना पकाउने ठाउँमा सुधारिएको चुलो प्रयोग गर्नु, ऊर्जा दक्ष उपकरण प्रयोग गर्नु आदि, इत्यादि ।

नेपाल जस्तो विकासोन्मुख देश जहाँ व्यापारिक ऊर्जा जम्मा ऊर्जा खपतको २० प्रतिशतको हाराहारीमा हुन्छ, त्यहाँ ऊर्जा दक्षताको विषय कसरी निकै सान्दर्भिक हुन सक्छ ? भनेर प्रश्न उठ्ने गरेका छन् ।

चित्र १ : यातायातमा ऊर्जा दक्षता (Wikipedia, 2018)



सामान्य सुधारिएको चुलोको प्रयोगबाट साधारण चुलो भन्दा ६० प्रतिशतसम्म दाउरा बचत हुन सक्छ । देशभरका सम्पूर्ण दाउराबाट बल्ने चुलो ऊर्जा दक्ष हुँदा त्यसले वातावरणमा पार्ने प्रभाव के हुन्छ ? करोडौं मानिसको स्वास्थ्य र अन्य आय-आर्जनका काम गर्न थप दिने समयको योगदान कति हुन्छ ? त्यसले गर्दा जङ्गल जोगाएर पर्यावरणमा पार्ने योगदान के हुन्छ ? ऊर्जा दक्षताको प्रभावकारिताबारे बुझ्न चाहने मान्छेले निकै सोचिरहनु पर्दैन । खाना पकाउँदा बचत हुने दाउरा र समय मात्र हेरे पुग्छ ।

नेपालको व्यापारिक ऊर्जामध्ये सम्पूर्ण खनिज ऊर्जाको आयात भारतबाट हुन्छ । नेपालमा दैनिक प्रयोग हुने पेट्रोलियम पदार्थमा ऊर्जा दक्षता प्रयोग गरेर जम्मा एक लिटर मात्र बचत भयो भने पनि देशले एक लिटरबराबरको पैसा जोगाउन सक्थ्यो । वास्तवमा नेपालमा यातायात क्षेत्रमा ऊर्जा दक्षताको प्रसङ्ग विश्वविद्यालयमा पनि उठेको भेटिंदैन । तर सामान्य हिसाब गर्दा पनि नेपालले अर्बौं-अर्ब रूपैयाँ बचाउन सक्छ । यो विषयमा चर्चा गर्नु अगाडि निम्न तथ्यांक हेरौं :-

नेपालले आफ्नो लागतको आधारमा जम्मा आयातको ४० प्रतिशत बढी पेट्रोलियम पदार्थ मात्र आयात गर्दछ । यो अङ्क करिब ११० मिलियन अमेरिकी डलर प्रतिमहिना बराबरको हो, जबकि, वार्षिक रूपमा नेपालले अन्तर्राष्ट्रिय बजारमा सामान पठाएर जम्मा गर्ने पैसा औसतमा यो भन्दा कम छ । यही तथ्यांकले पनि नेपाल ऊर्जा सुरक्षाको हिसाबले कति सुरक्षित छ भन्ने जानकारी दिन्छ ।

तर यातायात क्षेत्रमा हामीले ऊर्जा दक्ष प्रविधि वा कार्यक्रम लागू गर्दा निकै महत्वपूर्ण अङ्कमा पेट्रोलियम पदार्थ जोगाउन सक्छौं भन्ने स्पष्ट चित्र माथिको चार्टले पुष्टि गर्दछ । वास्तवमा नेपालमा बलियो खालको ऊर्जा दक्षतासम्बन्धी काम गर्ने सरकारी निकाय स्थापना गर्न ढिला भइसकेको छ ।

व्यापारिक ऊर्जामध्ये सबैभन्दा उन्नत ऊर्जाको स्रोत विद्युत क्षेत्रको ऊर्जा दक्षताबारे चर्चा गर्नु अगाडि नेपालको विद्युत ऊर्जा खपतमा सबैभन्दा बढी योगदान दिने बल्वबारे यो टेवल अध्ययन गरौं ।

एउटा आम उपभोक्ताले ऊर्जा दक्षताका सामान्य अभ्यासले मात्र पनि वार्षिक हजारौं रूपैया जोगाउन सक्छ भने विद्युत प्राधिकरणले यस्ता ग्राहकलाई थोरै विजुली दिएर बढीभन्दा बढी उपभोक्तालाई विद्युत वितरण गर्न सक्छ । आम उपभोक्तासँग रहेको करिब दुई लाख (६० वाटको) फिलामेन्ट चिम लिड बल्व फेर्दा मात्र पनि पिक समय (अधिकतम उपयोग हुने समय)मा १० मेघावाटसम्म विद्युत् बचत हुन सक्छ । वास्तवमा चिममा मात्र ऊर्जा दक्षता कार्यक्रम सफल बनाउन सके विद्युत् प्रणालीको उच्चतम माग १५० मेघावाटसम्मले घटाउन सकिन्छ । यो बराबरको विद्युत अन्य उत्पादक क्षेत्रमा लगाउँदा आउने प्रतिफल निकै ठूलो हुनेछ । यस्ताखाले आयोजनाको लगानी चुक्त गर्ने अवधि एक वर्ष पनि हुँदैन ।

नेपालका उद्योगले समग्र रूपमा चानचुन ४५० मेघावाट विद्युत् खपत गर्दछन् । वितरण केन्द्रमा कार्यरत इन्जिनियरको अनुभवमा धेरैजसो उद्योगको पावर फ्याक्टर ०.८ भन्दा पनि निकै तल रहेको उदाहरण छ । यसैपनि नेपाल विद्युत प्राधिकरणले पावर फ्याक्टरको सिमाना राखेको नै ०.८ हो ।

सबै उद्योगहरूलाई एउटै उपभोक्ता मानेर ४०० भोल्टको विद्युत पोटेन्सियलमा औसत पावर फ्याक्टर ०.९ छ र यसलाई स्वचालित पावर फ्याक्टर नियन्त्रकद्वारा ०.९९ पुऱ्याउँदा समग्र विद्युत प्रणालीबाट ठूलो मात्रामा रियाक्टिभ करेन्ट घट्दछ अर्थात् करिब ७८ एमभिएआर रियाक्टिभ पावर बोकेर हिंड्न पर्दैन र ठूलो मात्रामा प्रसारण लाइनको भार कम हुन्छ । अझै पावर फ्याक्टर ०.८ छ भनेर मान्ने हो भने १८६ एमभीएआर रियाक्टिभ पावर बोकेर हिंड्न पर्दैन । यसले नेपाल विद्युत् प्राधिरणको वितरण प्रणालीमा घटाउने विद्युत् क्षति निकै कम हुन्छ र विद्युत् गृहले यस प्रकारको विद्युत् शक्ति उत्पादन गर्न नपर्दा बिग्रने समस्या कम हुन जान्छ ।

बत्तीको अर्थशास्त्र

संज्ञा	इन्कन्डिसेन्ट चिम	फ्लोरोसेन्ट चिम	सिएफएल चिम	लिड चिम
लुमेन प्रतिवाट	११.६७	५०	४८	८५
चाहिने उज्यालोबराबरको क्षमताको चिम (वाट)	६०	३६	१८	९
जीवनचक्र (घण्टा)	१,०००	१५,०००	१०,०००	५०,०००
प्रतिचिमको लागत (रूपैयाँ)	२०	१२०	२४०	१८०
५०,००० घन्टाका लागि जम्मा चिम संङ्ख्या	५०	३.३	५	१
५०,००० घन्टाका लागि जम्मा बिजुली खपत (युनिट)	३,०००	१,८००	९००	४५०
५०,००० घन्टामा खर्च(रूपैयाँ) (रू. १२ प्रतियुनिट)	३६,०००	२१,६००	१०,८००	५,४००
५०,००० घण्टामा चिमको खर्च (रूपैयाँ)	१,०००	४००	१,२००	१८०
५०,००० घन्टामा चिमको जम्मा खर्च (रूपैयाँ)	३७,०००	२२,०००	१२,०००	५,५८०
एक वर्षमा एउटा चिम ५ घण्टा बाल्दा लाग्ने खर्च (रूपैयाँ)	१,३५१	८०३	४३८	२०४

आफ्नो आवश्यकतालाई थोरै स्रोत प्रयोग गर्दा पनि पुग्छ भने फजुल खर्च गरेर कसैले कमाउँदैन, बरू राज्यले गुमाउँछ ।

यसप्रकारको स्वचालित पावर फ्याक्टर नियन्त्रक राख्दा उद्योग पावर फ्याक्टर पेनाल्टीबाट जोगिन सक्छन् । उनीहरूको डिमाण्ड चार्ज घटेर जान्छ भने त्यही केभीए क्षमतामा अरू बढी विद्युतीय उपकरण चलाउन सक्छन् । त्यस्तै उद्योगमा आएको विद्युत्को भोल्टेजको पोटेन्सियल सुधारिएको हुन्छ । केही मात्रामा भए पनि उनीहरूको उद्योगभित्र विद्युत् क्षति पनि कम भएर जान्छ ।

सामान्यतया यस प्रकारको स्वचालित पावर फ्याक्टर नियन्त्रक राखेर उद्योगीको लागत फिर्ता आउने समय करिब ३/४ वर्ष लाग्न सक्छ । समग्र प्रणालीमा निकै सकारात्मक प्रतिफल आउने हुँदा नेपाल विद्युत प्राधिकरणले केही समय डिमान्ड शुल्कमा छुट दिएर नेपाल सरकारले स्वचालित पावर फ्याक्टर नियन्त्रकको खरिदमा कर र भ्याट छुट दिएर पनि उद्योगीको लागत फिर्ता आउने समय १/२ वर्ष बनाउन सकेमात्र पनि समग्र अर्थतन्त्रमा धेरै राम्रो प्रभाव पर्न सक्नेछ ।

ऊर्जा दक्षता आफैंमा निकै बहुआयामिक विषय हो । यो लेखमा उद्योगमा विद्युत बाहेकका अन्य रूपमा प्रयोग हुने ऊर्जा स्रोत, सडकबत्ती, नेपालमा असीमित सम्भावना बोकेको विद्युतीय पंखा र पम्प, मोटर, डिमान्ड साइड म्यानेजमेन्ट आदि जस्ता वृहत विषयबारे चर्चा गरिएको छैन ।

ऊर्जा दक्षता हासिल गर्ने रणनीति

अन्त्यमा, विद्यत् शक्तिको पुन:प्रयोग गर्नु नै ऊर्जा दक्षता हो । अर्थात् एउटा electricial appliance लाई पूर्णक्षमतामा चलाई प्राप्त गर्नुपर्ने सम्पूर्ण power factor तथा लाइन, मेशिनबाट हुने चुहावटलाई न्यूनिकरण गरी प्राप्त गर्ने बढीभन्दा बढी ऊर्जालाई नै ऊर्जा दक्षता भनिन्छ । त्यसैले, ऊर्जा दक्षता हासील गर्न नेपाल सरकार तथा ने.वि.प्रा. बाट निम्न कार्य गर्नुपर्ने देखिन्छ :

- नेपाल सरकार तथा ने.वि.प्रा.बाट ऊर्जा दक्षता प्राप्त गर्ने, ऊर्जा दक्षता रणनीति '२०७४' (हाल मस्यौदामा रहेको) लाई प्रभावकारी रूपमा लागू गर्नुपर्ने ।
- ऊर्जा दक्षता सम्बन्धमा ग्राहकवर्गसम्म सूचनामूलक कार्यक्रम तयार गरी awareness program सञ्चालन गर्नुपर्दछ ।
- Power factor तथा voltage सुधार गर्न आवश्यक पर्ने विद्युतीय उपकरणले अधिराज्यव्यापी पावर फ्याक्टर तथा voltage चेक गरी Automatic power factor correction panel हरू तुरून्त जडान गर्ने ।
- ऊर्जा दक्षता Equipment को बढीभन्दा बढी प्रयोग गर्न ने.वि.प्रा.बाट कार्यविधि विनियमावलीमा सुधार गरी अनिवार्य प्रयोग गर्न ने.वि.प्रा. स्वयं तथा ग्राहकवर्गसम्म जानकारी गराउने व्यवस्था मिलाउने ।
- Energy efficient equipment जस्तै :- Led bulb, efficient motor, fan, refrigerator तथा अन्य विद्युतीय उपकरणलाई नेपाल वा विदेशमा रहेको उच्च प्रयोगशालाबाट प्रमाणित गरी ग्राहकलाई नेपाल सरकार तथा ने.वि.प्रा.को खर्चबाट subsidy व्यवस्था गरी पुरानो विद्युतीय उपकरण बदली गर्ने व्यवस्था मिलाउनु पर्ने ।
- केही विद्युतीय सामग्रीहरूलाई ने.वि.प्रा.बाट Brand Ambassador घोषणा गर्ने ।
- विद्युतीय उपकरणको उपयोग सम्बन्धमा जनचेतनामूलक सामग्री टि.भी., रेडियोबाट प्रसारण गरी विद्युतको efficient प्रयोग सम्बन्धमा जानकारी गराउने ।
- अनावश्यक समयमा विद्युतीय सामग्रीको प्रयोग कम गर्ने ।
- विद्युतीय सामग्रीको आयात गर्दा भन्सार कार्यालयमा Quality Control Department राखी p.f. value अति न्यून अर्थात् NEA मापदण्डभन्दा कम भएका आयातित वस्तुको नियन्त्रण हुन सकेमा ठूलो मात्रामा विद्युत् शक्तिको उपयोग हुने देखिन्छ । यसले गर्दा Imported power को मात्रामा तात्विक फरक पर्नेछ ।

उपसंहार

विद्युत आफैंमा एउटा कच्चा पदार्थ हो । अहिलेको विश्वमा कसको आर्थिक अवस्था कस्तो हुने भन्ने कुराको निर्धारण उसले कति ऊर्जा उत्पादनमा लगाएको छ भन्ने कुरामा निर्भर गर्दछ । आफ्नो आवश्यकतालाई थोरै स्रोत प्रयोग गर्दा पनि पुग्छ भने फजुल खर्च गरेर कसैले कमाउँदैन, बरू राज्यले गुमाउँछ । नेपालकै परिप्रेक्ष्यमा अहिले हामीले कम खपत गरेर आफ्ना आवश्यकता पूरा गर्दा धेरै उज्यालोमा बस्न पाउँछौ । पेट्रोलियम पदार्थको आयात घट्छ, त्यस बाहेक महङ्गोमा किनिएको विद्युत्को परिमाण पनि घट्छ ।

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कार्यसम्पादन व्यवस्थापन संगठनको सफलताको आधार

कपिलचन्द्र बस्ताकोटी
प्रशासकीय अधिकृत, मध्यमर्स्याङ्ददी जलविद्युत केन्द्र, नेपाल विद्युत प्राधिकरण

विषयप्रवेश

कुनै पनि संगठन/संस्था निश्चित उद्देश्य हासिल गर्ने वा सेवाग्राहीलाई निश्चित सेवा प्रदान गर्ने उद्देश्यले स्थापना गरिएको हुन्छ । सरकारले पनि राज्य सञ्चालनका लागि जति पनि संयन्त्र (मन्त्रालय, सचिवालय, आयोग, परिषद्, विभाग, क्षेत्रीय कार्यालय, शाखा कार्यालय, जिल्ला कार्यालय, इकाई कार्यालय, संस्थान, बोर्ड, कम्पनी, समिति आदि) तयार गरेको हुन्छ, ती सबै आम जनता/नागरिकको हित, उन्नती एवं सेवाकै लागि स्थापित भएका हुन्छन् । यस्ता संयन्त्रद्वारा जनता/नागरिकमा सेवा प्रवाह गर्दा अमूक-अमूक क्षेत्रमा तोकिएका कार्य सम्पन्न गर्नैपर्ने हुन्छ । यही काम अथवा सेवा प्रवाहकै खातिर सरकारले आफ्ना संयन्त्र/निकायमा आवश्यक कर्मचारी/कामदार नियुक्त/भर्ना गरेको हुन्छ । तोकिएको काम गर्न नसके वा काम नभए जनता/नागरिकको सेवा गरेको मानिंदैन । संगठनले सम्पन्न गर्नुपर्ने काम फछ्र्यौट नगरेसम्म जनता/सेवाग्राहीप्रतिको दायित्व पूरा गरेको ठहरिंदैन ।

अर्कातर्फ काम नभए संगठन/संस्थाको उद्देश्य हासिल हुन सक्दैन । संगठन/संस्थाको उद्देश्य हासिल गर्न साधन (भौतिक, मानवीय, आर्थिक, सूचना)को परिचालन गर्नु आवश्यक हुन्छ । त्यसैले संगठन/संस्थाको साधनको परिचालन गर्न तथा अमूक उद्देश्य र लक्ष्य हासिल गर्न 'कार्य सम्पादन' नै अपरिहार्य तत्व हो । सीमित स्रोत र साधनलाई प्रभावकारी तरिकाले उपयोग गरी संगठन/संस्थालाई बढीभन्दा बढी उपलब्धि हासिल गराउने प्रयोजनका लागि नै 'कार्यसम्पादन व्यवस्थापन'को अवधारणा अघि सारिएको हो । प्रस्तुत लेखमा आधुनिक शासनव्यवस्थामा बढ्दै गएको 'कार्यसम्पादन व्यवस्थापन'को प्रयोग र महत्वलाई मध्यनजर गर्दै यसका विभिन्न पक्षमा संक्षिप्त विवेचना गर्ने प्रयास गरिएको छ ।

कार्यसम्पादन व्यवस्थापन (Performance Management)को परिचय

कार्यसम्पादन व्यवस्थापनका सम्बन्धमा जानकारी हासिल गर्न 'कार्यसम्पादन' र 'व्यवस्थापन' शब्दको छुट्टाछुट्टै अर्थ थाहा पाउन आवश्यक र उपयुक्त देखिन्छ ।

कार्यसम्पादन (Performance)

सामान्य अर्थमा व्यक्ति वा संस्था विशेषबाट भए गरेको कामकारबाहीलाई कार्यसम्पादन (Performance) भनिन्छ । कार्यसम्पादनले सम्पन्न गरिएको कार्यको परिमाण र गुणस्तर दुवैलाई जनाउँछ । कुनै पनि कार्य पूरा गर्ने प्रक्रिया, प्रयास तथा त्यस्तो कार्यबाट हासिल हुने नतिजालाई कार्यसम्पादन भन्न सकिन्छ । कार्यसम्पादन एउटा जटिल विषयवस्तु हो, जसले साधनको प्राप्ति एवं उपलब्धता र सो को उपयोगबाट हासिल हुने उपलब्धि एवं नतिजासँग सरोकार राख्छ । कुनै काम वा कार्यको कार्यान्वयन नै वास्तवमा कार्यसम्पादन हो ।

कार्यसम्पादनले कुनै पनि संस्था वा निकायमा कार्यरत कामदार/कर्मचारीको कार्यसँग सरोकार राख्छ । यसअर्थमा भन्दा संगठनमा कार्यरत कामदार/कर्मचारीको कार्यक्षमताको उपयोग नै कार्यसम्पादन हो ।

व्यवस्थापन (Management)

अर्कोतर्फ संगठनका निर्दिष्ट उद्देश्य हासिल गर्नका लागि संचालन गरिने क्रियाकलापको समष्टि रूप नै व्यवस्थापन (Management) हो । व्यवस्थापनविद् Henry Foyal ले व्यवस्थापनलाई `To manage is to forecas to plan, to organize, to command, to co-ordinate and to control भनी परिभाषित गर्नुभएको छ । त्यस्तैगरी Claude S. George ले Management consists of getting things done through others, a manager is a man who accomplishes objectives by directing the efforts of others भनी व्यवस्थापन र व्यवस्थापकको अर्थ प्रस्ट्याउनुभएको छ । यी परिभाषा समेतलाई मनन गर्दा व्यवस्थापन भनेको अरूबाट कार्य सम्पादन गराउने कला हो । निर्धारित लक्ष्य तथा उद्देश्य हासिल हुने गरी उपलब्ध स्रोतको समुचित उपयोगको व्यवस्था गर्नु व्यवस्थापन हो ।

कार्यसम्पादन व्यवस्थापन (Performance Management)

माथिका दुवै Terminology कार्यसम्पादन (Performance) र व्यवस्थापन (Management) को समिश्रण रूप कार्यसम्पादन व्यवस्थापन (PerformanceManagement) हो । कार्यसम्पादन व्यवस्थापन मानव संशाधन व्यवस्थापनको एक नयाँ आयाम हो । व्यवस्थापनको क्षेत्रमा यो नवीन अवधारणा हो । यसअन्तर्गत संगठनले आफ्ना उद्देश्य हासिल गर्न कर्मचारी तथा संस्थाको कार्यसम्पादन स्तरलाई कसरी व्यवस्थित गर्दछ भन्ने कुराको अध्ययन गरिन्छ । अब कार्यसम्पादन व्यवस्थापन के हो त ? भन्ने कुराको अध्ययन गरौं ।

कार्यसम्पादन व्यवस्थापन के हो ?

- कार्यसम्पादन व्यवस्थापन एउटा प्रक्रिया हो, जसले तालिम, उत्प्रेरणा र अन्य प्रोत्साहनद्वारा व्यवस्थापकलाई संगठनको कार्यसम्पादनमा सुधार गर्नमा सघाउ पुऱ्याउँछ ।
- कार्यसम्पादन व्यवस्थापनले संगठनको कार्यस्थितिको विश्लेषण गर्न, कार्य सम्पादनमा समस्या किन विद्यमान रहन्छ भन्ने कुरा निश्चित गर्न र कामदार/कर्मचारी/अनुयायीले सामना गर्नुपरेका अडचन/कठिनाइसँग मिल्दो समाधान रणनीति छनौट गर्न व्यवस्थापक (Manager)लाई प्रयोग गर्न सजिलो हुने मार्ग निर्देशन उपलब्ध गराउँछ ।
- कार्यसम्पादन व्यवस्थापनले कर्मचारीवर्गलाई कसरी उपयोग गर्ने, तिनीहरूको क्रियाकलापलाई कसरी समीक्षा तथा मूल्याङ्कन गर्ने र व्यवस्थित ढंगबाट कसरी पृष्ठपोषण गर्ने भन्ने कुरालाई प्रस्ट्याउँछ ।
- कमभन्दा कम स्रोतसाधनको उपयोगबाट बढीभन्दा बढी उपलब्धि हासिल गर्नु नै कार्यसम्पादन व्यवस्थापनको मूलभूत उद्देश्य हो ।
- सरकारको कामकारबाहीको प्रभावकारिता, जनतालाई उपलब्ध गराइएको सेवाको गुणस्तर र उपलब्ध सेवाबाट जनताको जीवनस्तरमा पर्न गएको प्रभावलाई कार्यसम्पादन व्यवस्थापनमा प्रत्यक्ष सरोकार राखिन्छ ।

कार्यसम्पादन व्यवस्थापनको उद्देश्य

- भए गरेका कामकारबाहीबाट अपेक्षित नतिजा हासिल गर्नु ।
- संगठनको प्रतिस्पर्धात्मक क्षमता अभिवृद्धि गर्नु ।
- संगठनको कामकारबाहीका माध्यमबाट जनताप्रतिको उत्तरदायित्व बहन गर्नु ।
- संगठनको उद्देश्य हासिल गर्न Team Work को प्रबर्द्धन गर्नु ।
- संगठनमा कार्यरत कामदार/कर्मचारीलाई उत्प्रेरित तथा प्रोत्साहित गर्नु ।
- संगठनमा प्रभावकारी सञ्चार प्रणालीको विकास गर्नु ।
- कामदार/कर्मचारी र संगठन पूरैको सम्पादित कामको मापन गर्नु ।
- आवधिक कार्यसम्पादनको समीक्षा गरी सुधारात्मक कदम चाल्नु ।
- कार्यसम्पादनमा आधारित प्रोत्साहन व्यवस्था लागू गर्नु ।
- कार्यसम्पादनमा आधारित संस्थागत सुशासन कायम गर्नु ।

कार्यसम्पादन व्यवस्थापनको क्षेत्र

- कामदार/कर्मचारी
- केन्द्रीय संगठन
- विभाग र शाखा
- कार्यप्रक्रिया र प्रविधि (Process & Technology)
- कार्यक्रम (Programs)
- ग्राहकका लागि उपलब्ध वस्तु तथा सेवा

कार्यसम्पादन व्यवस्थापनका चरण (Steps)

- संगठनको दूरदृष्टि (Vision), बृहत उद्देश्य (Mission), उद्देश्य (Objectives), लक्ष्य (Goal) र रणनीति (Strategy) तय गर्ने ।
- कार्यसम्पादन व्यवस्थापनबाट प्राप्त गर्न सकिने अपेक्षित नतिजाको निर्धारण गर्ने ।

- अपेक्षित नतिजा र हासिल नतिजाबीच तादाम्यताको सुनिश्चितता गर्ने ।
- अपेक्षित नतिजाको भार (Weightage) तोक्ने र प्राथमिकीकरण (Prioritizing) गर्ने ।
- कार्यसम्पादन मापन गर्नका लागि सूचकाङ्क (Indicators) निर्धारण गर्ने ।
- कार्यसम्पादन योजना (Performance Plan) तयार गर्ने ।
- कार्यसम्पादन योजनाअन्तर्गत विभिन्न क्रियाकलापको निरन्तर अवलोकन (Continuous Observation) तथा मापन गर्ने ।
- कार्य सञ्चालनको स्थितिबारे निरन्तर अवलोकनबाट देखिन आएका समस्या तथा कठिनाइलाई तत्काले समाधान हुने गरी सम्वद्ध व्यक्ति तथा निकायबाट पृष्ठपोषण (Feedback) उपलब्ध गराउने ।
- यथार्थमा हासिल भएका उपलब्धि (कार्यसम्पादन)को मूल्याङ्कन गर्ने ।
- राम्रा र निर्धारित स्तर पूरा गरेका कर्मचारीलाई राम्रो कार्यसम्पादनबापत पुरस्कृत गर्ने ।
- यथार्थमा कार्यसुधार हुन नसकेमा कार्यसम्पादन सुधार योजना तयार गरी लागू गर्ने ।
- कार्यसम्पादन स्तर (Performance Standard) लाई स्वीकार्य स्तरमा पुऱ्याउने ।

कार्यसम्पादन व्यवस्थापनसँग सम्बन्धित केही महत्वपूर्ण Terminology

कार्यसम्पादन स्तर (Performance Standard)

कार्यसम्पादन व्यवस्थापनलाई व्यवहारमा लागू गर्नका लागि सम्पादन गरिने कार्यको बाञ्छित स्तर निर्धारण गर्नुपर्ने हुन्छ । कुनै पनि कार्यको कार्यसम्पादन स्तर निर्धारण गर्नुपर्दा त्यस्तो कार्यलाई कस्तो किसिमबाट पूरा गर्ने भन्ने कुरा अग्रिम रूपमा स्पष्ट गरिनुपर्दछ । कार्यसम्पादनको स्तरले कुन मापन अर्थात् स्तरसँग तुलना गरी यथार्थ कार्यसम्पादनलाई मूल्याङ्कन गर्ने भन्ने आधार कायम गर्नेछ । कार्यसम्पादन स्तरले कार्यसम्पादन मूल्याङ्कन गर्नका लागि मापन चिन्ह अर्थात स्तर निर्धारण (Benchmark) उपलब्ध गराउँछ । यसले उत्पादन वा सेवाको उच्चतम बिन्दुको आधार निश्चित गर्नेछ । कार्यसम्पादन स्तरले प्रत्येक कार्यलाई कस्तो स्तरीयताका साथ अर्थात् कसरी अपेक्षा गरिएबमोजिम वा सो भन्दा पनि बढी राम्रोसँग सम्पन्न गरिनुपर्ने छ भन्ने बुझाउँछ ।

कुनै पनि कार्यको कार्यसम्पादन स्तर निर्धारण गर्नुपर्दा त्यस्तो कार्यलाई कस्तो किसिमबाट पूरा गर्ने भन्ने कुरा अग्रिम रूपमा स्पष्ट गरिनुपर्दछ ।

कार्यसम्पादनस्तरको आधारमा नै कर्मचारीको मूल्याङ्कन गरिन्छ । प्रत्येक कर्मचारीबाट अपेक्षित कार्य कुन हदसम्म पूरा हुन सकेको छ भन्ने प्रश्नको उत्तर कार्यसम्पादनस्तरको आधारमा थाहा पाउन सकिन्छ । कार्यसम्पादनस्तरको निर्धारण गर्दा सम्बद्ध कर्मचारीको प्रत्यक्ष संलग्नता रहनु आवश्यक हुन्छ । कार्यसम्पादन स्तर निर्धारण गरिंदा संगठनको उद्देश्य तथा स्तरसँग तादाम्यता रहनुपर्ने हुन्छ । कार्यसम्पादन स्तरलाई एकदमै कम तोकिएको अवस्थामा त्यस्तो स्तर त हासिल हुन्छ तर तोकिएको स्तरभन्दा बढी कार्यसम्पादन हुन सक्ने सम्भावना कम रहन्छ । त्यस्तैगरी कर्मचारीको कार्यसम्पादन स्तरलाई एकदमै बढी तोकिएको अवस्थामा कर्मचारी त्यस्तो बढी स्तर हासिल गर्न प्रयत्नशील रहने भएपनि तोकिएको उपलब्धि हासिल हुन नसक्दा उत्प्रेरित हुने सम्भावना कमै रहन्छ ।

कार्यसम्पादन स्तरलाई प्रभावकारी तुल्याउन कार्यसम्पादनसम्बन्धी स्तर निर्धारण गर्दा निम्न पक्षलाई ध्यान दिनु उपयुक्त हुन्छ ।

(क) S = Stretching **(विस्तृत रूपमा वर्णन)** : कार्यसम्पादनको स्तरबारे स्पष्ट एवं विस्तृत रुपमा व्याख्या गरिनुपर्दछ । जस्तै : त्यस्तो कार्य किन गर्नुपर्दछ, नगर्दा के हुन्छ, गर्दा क-कसलाई के के फाइदा हुन्छ, त्यस्तो कार्य कस्तो ढंगबाट कुन विधिले गर्नुपर्दछ आदि ।

(ख) M = Measurable **(मापन योग्य)** : प्रत्येक कार्यको कार्यसम्पादन स्तर निर्धारण गर्दा यथार्थ कार्यसम्पादन मापन गर्न सकिने खालको हुनुपर्नेछ । जस्तै : दिनमा कति जना ग्राहक बनाउनु पर्ने हो, एउटा मेशिन कति दिनमा फिट गरि सक्नु पर्ने हो, महिनामा कति राजस्व/आय संकलन गर्नुपर्ने हो, एक वर्षमा कति नाफाआर्जन गर्नु पर्ने हो आदि ।

(ग) A = Agreeable **(स्वीकार योग्य)** : कार्यसम्पादन मापनका स्तर निश्चित गर्दा व्यवस्थापन र कर्मचारी दुवै पक्षलाई स्वीकार्य हुनुपर्नेछ । जस्तैः कामदार/कर्मचारी सकेसम्म कम जिम्मेवारी लिन चाहन्छ तर संगठनले धेरै जिम्मेवारी दिएर उनीहरूबाट धेरै काम लिन चाहन्छ । यस्तोमा दुवैलाई स्वीकार्य हुने विन्दु नखोजे मनोमालिन्य उत्पन्न हुन्छ । कर्मचारीले त्यस्तो स्तर हासिल गर्न सकिंदैन भन्ने तर व्यवस्थापनले गर्न सकिन्छ, गर्नुपर्छ भन्ने अवस्था रहनु तोकिएको स्तर दुवै पक्षलाई स्वीकारयोग्य नहुनु हो ।

(घ) R = Realistic/Relavant **(यथार्थपरक, सान्दर्भिक)** कार्यसम्पादन मापनका स्तर वास्तविकतामा आधारित, सान्दर्भिक र पूरा गर्न सकिने खालको हुनुपर्दछ । जस्तै :

ने.वि.प्रा.मा एकैदिनमा पचास हजार ग्राहक थप गर्ने भन्ने कामको स्तर तय गरियो भने त्यो पूरा हुन सक्दैन । त्यस्तै राजमार्गमा कतिजना मानिस खुट्टाले हिंड्छन् भनेर मान्छे गन्ने स्तर कायम गर्नु सान्दर्भिक विषय ठहरिँदैन ।

(ङ) T = Time Bound **(समय पावन्दी)** : कार्यसम्पादन स्तर तोकिएबमोजिमको समयावधि सम्बन्धित अर्थात् कुन समयावधिका लागि हो भन्ने कुरा स्पष्ट हुनुपर्दछ । जस्तै : दैनिक, साप्ताहिक, मासिक, अर्धवार्षिक, वार्षिक आदि ।

कार्यसम्पादन मापन (Performance Measurement)

कार्यसम्पादन व्यवस्थापनमा सम्पादित कामको मापन गर्ने कार्य अत्यन्तै महत्वपूर्ण पक्ष हो । संगठनका निर्दिष्ट लक्ष्य हासिल गर्न सञ्चालन गरिएका क्रियाकलापको सही मापनबाट नै अपेक्षित उपलब्धि हासिल भए, नभएको निश्चित गर्न सकिन्छ । कार्यसम्पादन स्तर (Performance Standard)ले हासिल गर्नु पर्ने कुरालाई प्रस्ट्याउँछन् भने कार्यसम्पादनको मापनबाट हासिल भएको उपलब्धिलाई यकिन गर्न सम्भव हुन्छ । कार्यसम्पादन मापन (Performance Measurement) बाट नै व्यक्तिविशेषको कार्यसम्पादनको स्थिति यकिन हुन सक्दछ । यसबाट कर्मचारीको सामर्थ्यता एवं कार्यकुशलता थाहा पाउन सकिन्छ । कार्यसम्पादन मापनबाट नै कुनै पनि कर्मचारीको वास्तविक कार्यसम्पादन स्थितिबारे व्यवस्थापनलाई जानकारी प्राप्त हुन्छ ।

कार्यसम्पादन सूचक (Performance Indicators)

कार्यसम्पादन व्यवस्थापनलाई प्रभावकारी तुल्याउन विभिन्न कार्य सम्पादन सूचकको आवश्यकता पर्दछ । कार्यसम्पादन सूचकको विकास तथा प्रयोगले कार्यसम्पादन मूल्याङ्कनमा सहयोग पुऱ्याउँछ । कार्यसम्पादन सूचकलाई सफलताको सूचक (Success Indicator) पनि भन्ने गरिएको छ । कार्यसम्पादन सूचकले कुनै पनि संगठनको लक्ष्यको व्याख्या तथा प्रगति मापन गर्नमा सघाउ पुऱ्याउँछ । संगठनद्वारा जे, जस्ता कार्यसम्पादन सूचकलाई छनौट गरिएको भए तापनि तिनले संगठनका लक्ष्यलाई प्रतिविम्बित गर्नुपर्दछ । त्यस्ता सूचकले संगठनात्मक सफलता हासिल गर्ने आधारको विकास गर्नुपर्दछ र परिमाणात्मक आधारमा मापन योग्य हुनुपर्नेछ ।

कार्यसम्पादन सूचकमा हुनुपर्ने गुण

- स्वच्छता (Fairness)
- प्रभावकारिता (Effectiveness)
- कार्यकुशलता (Efficiency)
- जवाफदेहिता (Responsiveness)
- एकीकरण (Integration)
- उत्तरदायित्व (Accountability)
- पारदर्शिता (Transparency)
- लचकता (Flexibility)
- स्वायत्तता (Autonomy)

सूचकको वर्गीकरण (Classification of Indicators)

- साधनसम्बन्धी सूचक (Input Indicator)
- उपलब्धिसम्बन्धी सूचक (Output Indicator)
- परिणामसम्बन्धी सूचक (Outcome Indicator)
- प्रक्रियासम्बन्धी सूचक (Process Indicator)

कार्यसम्पादन व्यवस्थापन प्रणाली लागू गर्दा आइपर्ने बाधक तत्व (Constraints)

- संगठनको कार्य संस्कृति (Work Culture)
- संस्थागत विखण्डन (Institutional Fragmentation)
- जनता/नागरिक/सेवाग्राहीको उदासिनता (Public Apathy)
- नेतृत्वको असहयोग (Leadership Non-Support)
- व्यवसायिक वातावरण (Business Invironment)

प्रभावकारी कार्यसम्पादन व्यवस्थापन प्रणाली लागू गर्नका लागि पूर्वशर्त (Pre-Requisites)

- उच्च व्यवस्थापनको बलियो प्रतिबद्धता (Strong Commitment of Top Management) ।
- सबै कर्मचारीको उच्च सहभागिता (High Level Participation of Employees) ।
- Performance Parameter को पहिचान (Identification of Performance Parameters) ।
- Key Performance Indicator को स्पष्ट परिभाषा (Clear Definition of Key Performance Indicator (KPIs) ।
- पर्याप्त संगठनात्मक तालिम (Adequate Organizational Training) ।
- Reward र Recognition लाई प्रणाली (System) को प्रारम्भिक तत्वका रूपमा लिइनुपर्ने र मूल्यांकन (Appraisal) सँग मात्र Link गरिनुपर्ने (Reward &Recognition Linkage with Appraisal) ।

नेपाल विद्युत प्राधिकरणमा कार्यसम्पादन व्यवस्थापनको प्रयोग

नेपालको सार्वजनिक क्षेत्रमा कार्यसम्पादन व्यवस्थापनको प्रयोग हुँदै नभएको होइन । सार्वजनिक सेवामा कार्यरत कर्मचारीको कार्यसम्पादन मूल्याङ्कनलाई उपलब्धिमा

आधारित गर्ने पारिपाटीलाई सन् १९७० को दशकबाट थालनी गरेको पाइन्छ । नेपालको सार्वजनिक व्यवस्थापनमा कार्यसम्पादन व्यवस्थापनको वास्तविक थालनी वि.सं. २०५८ सालबाट भएको हो । नतिजामुखी एवं जनउत्तरदायी प्रशासकीय वातावरणबाट जनतालाई प्रदान गरिने सेवाको स्तरमा अभिवृद्धि गर्न एसियाली विकास बैंकको सहयोगमा शासकीय सुधार कार्यक्रम लागू गरी यसअन्तर्गत नेपाल सरकारले केही मन्त्रालयमा कार्यसम्पादनमा आधारित व्यवस्थापन प्रणाली स्थापना गर्ने कार्यको थालनी गरेको देखिन्छ ।

नेपाल विद्युत प्राधिकरणले नेपाल सरकारको कार्यप्रणालीलाई नै अनुशरण गर्ने भएकाले त्यहाँको प्रभाव प्राधिकरणमा पनि निश्चित रूपमा पर्दछ । प्राधिकरणमा पनि कर्मचारीको समग्र पक्षको सुधारका लागि निरन्तर प्रयास भइरहेको पाइन्छ । कार्यसम्पादन व्यवस्थापन मानवीय संसाधन व्यवस्थापनको एउटा अंश भएको र समग्र संगठनको विकास र प्रगति कर्मचारीको विकासमा नै निर्भर गर्ने भएकाले कर्मचारीसँग सम्बन्धित प्रावधान नै कार्यसम्पादन व्यवस्थापनका लागि गरिएको प्रयास मान्न सकिन्छ ।

नेपाल विद्युत प्राधिकरण ऐन २०४१ तथा सो ऐनअन्तर्गत बनेका विभिन्न विनियमावलीका आधारमा नेपाल विद्युत प्राधिकरणको कार्यसम्पादन हुने गर्दछ । नेपाल विद्युत प्राधिकरण सञ्चालक समितिले आफ्ना विभिन्न विनियमावलीका माध्यमबाट प्राधिकरणका कर्मचारी तथा संस्थाकै कार्यसम्पादनमा सुधार ल्याउने हिसाबले विभिन्न व्यवस्था गरेको पाइन्छ । ती मध्ये केही महत्वपूर्ण प्रयोग र व्यवस्था यस प्रकार छन् ।

- ने.वि.प्रा.का कार्यकारी निर्देशक र नेपाल सरकार ऊर्जा जलस्रोत तथा सिँचाई मन्त्रालयबीच भएको कार्यसम्पादन सम्झौता (Performance Agreement) ।
- नेपाल विद्युत प्राधिकरण कर्मचारी सेवा विनियमावली २०६२ (संसोधनसहित) अनुसार गरिएको व्यवस्था :
- कार्यालय प्रमुखलगायत अधिकृत स्तरका विभिन्न पदको कार्यविवरण तयार गरी लागू गरिएको ।
- कर्मचारीको बढुवा गर्न कर्मचारीको कार्यसम्पादन मूल्यांकनलाई मुख्य आधार बनाइएको ।
- कर्मचारीको मनोबल बढाउन र उनीहरूमा उत्प्रेरणा जगाउन विभिन्न प्रकारका सुविधा जस्तै विदा, औषधोपचार, घरभाडा, बिजुली सुविधा, बीमा, ग्रेड बृद्धि, दुर्गम भत्ता आदिको व्यवस्था गरिएको ।
- कर्मचारीमा कामप्रति लगाब वृद्धि गर्न विभिन्न प्रकारका आचरण तयार गरी लागू गरिएको ।
- प्राधिकरणको हितविपरीत कार्य गर्ने तथा तोकिएको आचरण उल्लंघन गर्ने कर्मचारीउपर विभिन्न आधारमा पाँच प्रकारका विभागीय सजाय गर्न सकिने व्यवस्था गरिएको ।
- कर्मचारीको वृत्तिविकास र उत्प्रेरणाका लागि निश्चित प्रावधानमा आधारित बढुवा प्रणाली लागू गरिएको ।
- कर्मचारीको क्षमता वृद्धि गरी कार्यसम्पादनमा सुधार ल्याउन सेवा समूहसँग सम्बन्धित विभिन्न तालिम (सेवा प्रवेश, सेवाकालीन, पुनर्ताजगी आदि)को व्यवस्था गरिएको ।

नेपाल विद्युत प्राधिकरण आर्थिक प्रशासन विनियमावली २०६८ (संसोधनसहित) अन्तर्गत गरिएका व्यवस्था

- प्राधिकरणको लेखा राख्ने ढाँचा, तरिका, खाता सञ्चालन विधि आदिको निश्चित व्यवस्था गरी लेखाप्रणालीलाई उत्तरदायी, छरितो र प्रमाणमा आधारित बनाई खर्च नियन्त्रणको व्यवस्था गरिएको ।
- कार्यालय प्रमुख, लेखा प्रमुख आदिको काम, कर्तव्य र अधिकार स्पष्ट गरिएको ।
- सम्पत्तिको जिम्मा, लगत, संरक्षणसम्बन्धी स्पष्ट व्यवस्था गरिएको ।
- प्राधिकरणको खरिद प्रक्रिया र ठेक्का प्रणालीलाई मितव्ययी, पारदर्शी र व्यवस्थित तुल्याइएको ।
- नेपाल विद्युत प्राधिकरण विद्युत वितरण विनियमावली २०६९ मार्फत ग्राहकको घरमा मिटर जडान गर्ने, जाँच्ने, मिटर रिडिङ्ग गर्ने तौरतरिका, कार्यविधि निश्चित गरी कर्मचारीको ग्राहक वा सेवाग्राहीप्रतिको काम कर्तव्य र दायित्वलाई स्पष्ट गरिएको ।
- नेपाल विद्युत प्राधिकरण भ्रमण खर्च विनियमावली २०६५ जारी गरी प्राधिकरणको काममा अन्यत्र जाँदा सो को खर्च कार्यालयले व्यहोर्ने व्यवस्था गरिएको ।
- कर्मचारी सापटीसम्बन्धी कार्यविधि २०६६ निर्माण गरी कर्मचारीहरूलाई उत्प्रेरणा स्वरूप विभिन्न किसिमका सापटी प्रदान गर्ने व्यवस्था गरिएको ।
- वितरण केन्द्र प्रमुख, शाखा प्रमुख लगायत कार्यालय प्रमुखसँग कार्यसम्पादन करार (Performance Contract) गर्ने गरिएको ।
- प्रधान कार्यालयमा जनसम्पर्क शाखाको स्थापना, सूचना अधिकारी र प्रवक्ताको व्यवस्था गरिएको ।
- लोकसेवा आयोगको परामर्शमा निष्पक्ष, पुर्वाग्रहरहित तवरले परीक्षा सञ्चालन गरी स्वच्छ प्रतिस्पर्धामार्फत् प्रतिभाशाली व्यक्तिलाई संस्थामा भित्र्याउने व्यवस्थाको अवलम्बन गरिएको ।
- सूचनाको हकसम्बन्धी ऐन, सुशासन (व्यवस्थापन तथा

सञ्चालन) ऐन र नियमावलीको आत्मसातको प्रयास गरिएको ।

- उत्पादन, प्रसारण र वितरण व्यवसायमा कार्यसम्पादनमा आधारित प्रोत्साहन भत्ता (EPR) को व्यवस्था गरिएको ।
- ने.वि.प्रा.का विभिन्न आयोजनामा आयोजनाको काम समयमा सम्पन्न गर्न गराउन कार्यप्रगतिका आधारमा भुक्तान हुने गरी कार्यसम्पादन भत्ता लागू गरिएको ।

नेपाल विद्युत प्राधिकरणमा 'कार्यसम्पादन व्यवस्थापन' लागू गर्न देखापरेका मूलभूत समस्या

- उच्च तहका पदाधिकारी र तल्ला स्तरका कर्मचारीबीच पारदर्शी सञ्चार प्रणाली (Two Way Communication System) को अभाव देखिएको ।
- संस्था/संगठनको कार्यसम्पादनमा सुधार ल्याउन कार्यसम्पादन सुधार योजना (Performance Improvement Plan) बनाई लागू गर्ने प्रयास नगरिएको ।
- विभिन्न केन्द्र प्रमुख, शाखा प्रमुखसँग कार्यसम्पादन करार गर्ने व्यवस्था गरिएको भए पनि त्यसमा निरन्तर राजनितिक हस्तक्षेप हुने गरेको देखिएको, जसका कारण Reward र Punishment को प्रावधानलाई पूर्ण रूपमा लागू गर्न नसकिएको ।
- कार्यसम्पादन व्यवस्थापनको मूलभूत आधार कार्यसम्पादन मूल्यांकन (Performance Appraisal) लाई निष्पक्ष रूपमा लागू गर्न नसकिएको । कर्मचारीको कामलाई भन्दा व्यक्तिको मुख हेरी मूल्यांकन गर्ने प्रवृत्ति हावी भएको ।
- संगठनमा पुरस्कार र दण्ड (Reward & Punishment) को व्यवस्थालाई कडाइका साथ लागू गर्न नसकिएको । जसको फलस्वरूप राम्रो काम गर्ने कामदार/कर्मचारीमा पनि संगठन प्रति वितृष्णा पैदा भएको ।
- कर्मचारीले सम्पादन गर्ने कामको वस्तुगत सूचक (Real Indicator) तयार गर्न नसकिएको । ठूलो संगठन र विविध प्रकारका कार्य (उत्पादन, प्रसारण, वितरण, इन्जिनियरिङ्ग सर्भे डिजाइन आदि) गर्ने संस्था भएकाले पनि हरेक कामको सूचक तयार गर्न सम्भव नभएको ।
- ने.वि.प्रा.भित्रको सरूवा, बढुवा प्रणालीमा बाहिरी/राजनीतिक हस्तक्षेप हुने गरेको । विशेषगरी सरूवा तथा पदस्थापनामा निष्पक्षता कायम गर्न नसकिएको । फलस्वरूप मर्कामा पर्ने कर्मचारीबाट संगठनले आशातित योगदान प्राप्त गर्न नसकेको । सरूवा बढुवा प्रणालीलाई स्वच्छ पारदर्शी बनाउने व्यवस्थापनको चाहना हुँदाहुँदै पनि ट्रेड युनियनको दबाब र अन्य बाहिरी प्रभाव थेग्न असम्भव देखिएको ।
- नेपाल विद्युत प्राधिकरणको आन्तरिक अनुगमन तथा मूल्यांकन प्रणाली (Monitoring and Evaluation System) कमजोर देखिएको । ग्राहक सेवा व्यवस्थापन, कर्मचारीहरूको कार्यसम्पादन शैलीको निरीक्षण र सुधार, आचरण तथा अनुशासनको अनुशरण गराउने जस्ता विषयमा पर्याप्त ध्यान पुग्न नसकेको गुनासो व्याप्त रहेको ।
- प्राधिकरणमा कर्मचारीको संख्या आवश्यकताभन्दा धेरै रहेको भन्ने बाहिरी क्षेत्रको विश्लेषण रहेको भए पनि संस्थाको दरबन्दी तथा कर्मचारी कटौतीतर्फ व्यवस्थापकको ध्यान पुग्न नसकेको । Staff Optimization को पद्धति अबलम्वन हुन सकेको नदेखिएको ।
- कार्यसम्पादन र उपलब्धिबीचको फरक (Performance Gap) पत्ता लगाउने संयन्त्र तयार पार्न नसकिएको । यस्तो संयन्त्रको अभावमा संगठनको उद्देश्य तथा लक्ष्यअनुसार उपलब्धि हासिल भएको छ कि छैन भन्ने सम्बन्धमा Input-Process-Output प्रणाली अवलम्वन गर्न नसकिएको ।
- कामको विशेषज्ञता, इमान्दारिता, व्यवस्थापकीय क्षमता र नेतृत्वक्षमता भएकालाई मात्र कार्यालय प्रमुखको जिम्मेवारी दिने परीपाटी बसाल्न सके त्यस्ता कुशल प्रमुखको नेतृत्वमा ने.वि.प्रा.को संगठनको समग्र कार्यसम्पादनमा सुधार आउने सबैलाई थाहा भए पनि त्यसको निश्चित मापदण्ड तयार गरी लागू गर्ने प्रयास नभएको ।

नेपाल विद्युत प्राधिकरणमा 'कार्यसम्पादन व्यवस्थापन'लाई प्रभावकारी रूपमा लागू गर्न चाल्नुपर्ने कदम

संस्था/संगठनको कार्यसम्पादन सुधार योजना (Performance Improvement Plan) तर्जुमा गरी कार्यान्वयन गर्ने । यस्तो सुधार योजनालाई निरन्तरता दिने, निरन्तरताका लागि कार्यसम्पादन सुधार कोष (Performance Improvement Fund) समेत स्थापना गर्ने ।

'कार्यसम्पादन सुधार कोष' संगठनले आफ्नो वार्षिक/आवधिक बजेट बनाउँदा आफ्नो कार्य प्रभावकारितामा वृद्धि गर्न छुट्याउने अन्य कोष (जस्तै : कर्मचारी कल्याण कोष, उपदान कोष आदि) जस्तै एक प्रकारको नियमित बजेट हो । भोली कार्यसम्पादन सुधार सम्बन्धी कुनै काम गर्नुपर्ने भयो भने के बाट खर्च गर्ने, बजेट छैन भन्ने अवस्थाको सृजना नहोस् भन्नका खातिर यस कोषको व्यवस्था गरिन्छ । कार्यसम्पादन सुधार कोषअन्तर्गत संगठनको कार्यसम्पादन सुधार योजनाद्वारा लक्षित उपलब्धि हासिल गर्नका लागि आवश्यक साधनमा खर्च गर्नको लागि विशेष व्यवस्था गरिन्छ । यो कोष संगठनका पूर्व निर्धारित उपलब्धि हासिल गर्नका लागि सञ्चालन गरिने क्रियाकलापका लागि थप स्रोतसाधनको व्यवस्था हो । यस्तो कोष स्थापनाको मूल उद्देश्य संगठनको कार्यसुधार योजना बजेट अभाव वा अन्य जुनसुकै बहानामा नरोकियोस् र रोक्नु नपरोस्, यस्तो

योजना तथा कार्यक्रम जहिलेसुकै निरन्तर रूपमा चालु गर्न सकियोस् भन्ने हो ।

कर्मचारीको तलब प्रणालीलाई कार्यसम्पादन प्रगतिसँग आवद्ध (Tie up) गराउने । राम्रो र धेरै काम गर्नेलाई धेरै सुविधा (तलब, भत्ता, बोनस आदि) तथा नराम्रो र थोरै काम गर्नेलाई थोरै सुविधा दिने प्रणाली लागू गर्ने अर्थात् कार्यसम्पादनमा आधारित तलब प्रणाली लागू गर्ने ।

कार्यसम्पादनमा आधारित तलव प्रणाली लागु गर्ने वा नगर्ने भन्ने कुरा सरकारको इच्छाशक्तिमा भर पर्छ । खाली यसका लागि केही पूर्वाधार पूरा गर्नुपर्ने हुन्छ । Performance Based Pay System लागू गर्ने भनेर सरकारले निर्णय गर्नुपर्दछ । यसका लागि आवश्यक कानुन र कार्यविधि तयार/पारित गर्नुपर्दछ । साथसाथै सबै कर्मचारीको Clear Job Description को व्यवस्था, कार्यउपलब्धि मापन, कार्यकुशलता मापन, कार्यदक्षताको मापन, उपलब्धिको स्तर निर्धारण आदिका निश्चित KeyIndicators, KeyRating तयार गर्नुपर्दछ । यी आधारभूत कुरा पुरा भएमा सरकारी क्षेत्रमा समेत Performance Based Pay System लागू गर्न सम्भव देखिन्छ । यस्तो Pay System निजी क्षेत्रमा मात्र लागू गर्न सकिने सरकारी क्षेत्रमा नसकिने भन्ने हुँदैन ।

सरकारले नियम, कार्यविधि नबनाई निजी क्षेत्रमा समेत यो लागू हुन सक्दैन । सरकारी क्षेत्रमा समेत लागू गर्न त्यही अनुसारको नियम, कार्यविधि, प्रविधि तयार गर्नु आवश्यक छ । सरकारी र निजी क्षेत्रमा मात्रै Volume (ठूलो र सानो क्षेत्र) को फरक हो । कार्यसम्पादनमा आधारित तलब प्रणाली संसारमा प्रचलित तलब प्रणालीमध्ये The Best Pay System हो । Pay for Performance (कामका लागि पैसा) यसको मूल तत्व हो ।

- NEA को आन्तरिक कार्य (जस्तै सरूवा, बढुवा, योजना आदि) मा बाहिरी/राजनीतिक प्रभाव र हस्तक्षेपको अवस्था शून्य बनाउनु पर्ने ।
- कार्यसम्पादन व्यवस्थापन कुनै एक वा दुई जनाको प्रयासले मात्र हुन नसक्ने भएकाले सबै कामदार/कर्मचारीलाई समाहित गर्ने संगठनमा सहभागितामूलक पद्धतिको अवलम्बन गर्ने ।
- संगठनमा पुरस्कार र दण्डको व्यवस्थालाई कडाइका साथ कार्यान्वयन गर्ने । तोकिएबमोजिम पूर्वनिर्धारित लक्ष्य हासिल गर्ने कार्यालाई एकाई र कर्मचारी दुवैलाई आर्थिक र गैरआर्थिक पुरस्कार उपलब्ध गराई उत्कृष्ट कार्यसम्पादन गर्न उत्प्रेरित गर्ने ।
- कर्मचारीको कार्यसम्पादन मूल्यांकन प्रणालीलाई वस्तुपरक बनाउने । काम गर्ने र नगर्ने दुवैलाई समान अंक दिने हालको प्रचलनको अन्त्य गर्ने । व्यक्तिको मुख हेरी मूल्यांकन गर्ने प्रवृत्तिलाई निरूत्साहित गर्ने । वास्तविक कार्यसम्पादनका आधारमा कर्मचारीको मूल्यांकन हुने परिपाटीको अवलम्वन गरी काम नगर्नेलाई पनि उत्कृष्ट कार्यसम्पादनतर्फ आकर्षित गर्ने । ३६० डिग्री कार्यसम्पादन मूल्यांकन समेत लागू गर्ने । मूल्यांकित कार्यसम्पादन मूल्यांकन फाराम अति गोप्य राख्ने संयन्त्र तयार गर्ने ।
- विभिन्न केन्द्र प्रमुख, शाखा प्रमुख तथा विभागीय प्रमुख सबैसँग स्वच्छ कार्यसम्पादन करार हुने व्यवस्था गरी त्यसमा Reward /Punishment को व्यवस्था आवद्ध गर्ने । कामको विशेषज्ञता, इमान्दारीता, व्यवस्थापकीय क्षमता र नेतृत्व क्षमता नभएकालाई कुनै पनि हालतमा कार्यालय प्रमुखको जिम्मेवारी नदिने ।
- ट्रेड युनियनको आचारसंहिता बनाई लागू गर्ने । ट्रेड युनियनको अस्तित्वलाई संगठनको कार्यसम्पादन प्रगतितर्फ निर्देशित गर्ने ।
- ने.वि.प्रा.का कार्यालयबाट हुने कार्यसम्पादनको अनुगमन तथा मूल्यांकन (Monitoring and Evaluation) प्रणालीलाई प्रभावकारी बनाउने । विशेषगरी ग्राहक सेवा व्यवस्थापन, कर्मचारीको कार्यसम्पादन शैलीको निरन्तर निरीक्षण गर्ने र त्यसमा आवश्यक सुधार गर्ने ।
- EPR लगायत आयोजनामा दिइने प्रोत्साहन भत्ताको वितरणमा वास्तविकताको अध्ययन गर्ने । खाली कागजात मात्र मिलाइएको छ कि वास्तवमा काम नै भएको छ ? सो सन्दर्भमा वास्तविकताको मुहान खोतल्न आधिकारीक निकायबाट नियमित रूपमा Field Visit गरी विषयवस्तुको सान्दर्भिकता पत्ता लगाउने प्रणालीको विकास गर्ने ।
- ने.वि.प्रा.मा कर्मचारी आवश्यकता भन्दा धेरै रहेको भन्ने आम जनगुनासोलाई मध्यनजर गरी अनावश्यक कर्मचारी कटौती गरी Staff Optimization गर्ने । यसका लागि NEA नै नबुझेका बाहिरी विशेषज्ञ भाडामा लिई नाम मात्रको O&M सर्भे गराउनु भन्दा ने.वि.प्रा.भित्रकै ११ र १० तहका ५/६ जना अधिकृतको विशेष टोली गठन गरी कति कर्मचारीले NEA सञ्चालन हुन सक्छ भन्ने सम्बन्धमा स्थलगत अध्ययनको ब्यवस्था गरी Staff Optimization सम्बन्धमा वास्तविक अध्ययन गराउने ।
- हरेक कर्मचारीको कार्य विवरण तयार गरी लागू गर्ने । त्यस्ता कार्य सम्भव भएसम्म Key Performance Indicator तयार गर्ने र लक्ष्य, कार्यसम्पादन र उपलब्धि (Goal, Performance & Output) बीच तुलना गर्न योग्य बनाउने ।

उपसंहार

संगठनसँग भएको आर्थिक साधन, मानवीय साधन, भौतिक साधन, सूचनाको साधन परिचालन गर्न 'कार्य' नै अपरिहार्य तत्व हो । साधनबीच समन्वय स्थापित गर्ने, साधनको

नेपाल विद्युत प्राधिकरणले आफ्ना उद्देश्य परिपूर्ति गर्ने गराउने क्रममा कार्यसम्पादन व्यवस्थापन प्रणालीलाई नै मजबुत र प्रभावकारी बनाउनु आवश्यक छ ।

महत्तम प्रयोग/उपयोग गर्ने, साधनलाई उपलब्धिमा परिणत गर्ने अवयव नै 'कार्य' हो । त्यसैले 'कार्य' बिना संगठनको कुनै पनि कार्यक्रम अगाडि बढ्न सक्दैन । संगठनमा, सबै कार्यक्रम र कार्यको सम्पादनको जिम्मा मानवीय संशाधन अथवा कर्मचारी/कामदारकै हुन्छ । कार्यसम्पादन नभएको अवस्थामा न कर्मचारीको हित र उन्नति हुन्छ, न त संगठन नै आफ्नो लक्ष्यमा पुग्न सक्छ । त्यसैले त आजकल व्यवस्थापनको क्षेत्रमा 'कार्यसम्पादन' शब्दको प्रयोगको महत्व बढ्दै गएको छ ।

संगठनको 'कार्यसम्पादन' जति ढिला र अव्यवस्थित हुन्छ, अमुक संगठन उति उति अधोगतितर्फ धकेलिन्छ । संगठनको 'कार्यसम्पादन'लाई जति प्रभावकारी बनाउन सकियो, संगठन त्यति त्यति सफलतातर्फ उन्मुख रहन्छ । त्यसैले 'कार्यसम्पादन व्यवस्थापन' संगठनको सफलताको आधार हो ।

नेपाल विद्युत प्राधिकरण एउटा फराकिलो सेवा क्षेत्र ओगटेको सार्वजनिक संस्थान भएका कारणले पनि यसले आफ्नो काम कारबाहीमा निष्पक्षता, प्रभावकारीता, निपुणता, उत्तरदायित्व बहन जस्ता विशेषता मिसाउनै पर्दछ । नेपाल विद्युत प्राधिकरणले आफ्ना उद्देश्य परिपूर्ति गर्ने गराउने क्रममा कार्यसम्पादन व्यवस्थापन प्रणालीलाई नै मजबुत र प्रभावकारी बनाउनु आवश्यक छ । क्रियाकलाप र कार्यको कार्यान्वयनबाट नै संस्था/संगठनको उद्देश्य हासिल हुने भएकाले कार्यसम्पादनलाई जति छिटो, छरितो, पारदर्शी, मितव्ययी बनाउन सक्यो, उति नै संगठन/संस्था गतिशील र उद्देश्योन्मुख अनि नतिजामुखी बन्न सक्छ । त्यसैले माथि उल्लेख भएका महत्वपूर्ण समस्याको निराकरणको व्यवस्था गरी सहभागितामूलक पद्धतिको अबलम्वनबाट सबै कर्मचारीको सामूहिक प्रयास प्रयोग गरी संगठनको समग्र कार्य अगाडि बढाएमा निश्चय नै नेपाल विद्युत प्राधिकरणमा 'कार्यसम्पादन व्यवस्थापन' को औचित्यता पुष्टि हुनेछ ।

सहयोगी स्रोत सामग्री

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www.wikipedia.org

कर्मचारी दुर्घटनामा परी औषधि उपचार गराएको अवस्थामा वीमा दावीका लागि आवश्यक कागजातहरू

- **आवश्यक विवरण भरिएको वीमा दावी फाराम**
- **औषधि उपचारका सम्पूर्ण सक्कल कागजात तथा बीलहरू**
- **कार्यालयले तयार पारेको दुर्घटना प्रतिवेदन**
  (कार्यालयको कामको शिलशिलामा दुर्घटनामा परेको अवस्थामा मात्र)
- **दुर्घटनाको प्रहरी प्रतिवेदन**
  (कार्यालयको कामको शिलशिलामा दुर्घटनामा परेको अवस्थामा मात्र)

Fostering Joint Initiative in Energy Cooperation between Nepal and India through Energy Banking

Prabal Adhikari
Chief, power Trade Department, NEA

1. Background

After the end of load shedding and its scars gradually being healed, voices of gaining independence in electricity are soaring in addition to the consumers' aspirations for the quality and reliability of power supply in the country. Building robust transmission and distribution system featured with necessary protection schemes is what present management is striving for so as to ensure quality and reliability of supply. However, independence of electricity can be achieved if some waves of massive upheavals leap into action in the power sector of Nepal which inherits the somber images of hydropower development from the past. Our poor performance to have generated just above 1000 MW hydro so far in one hundred and seven years is more than enough to depict the gloom hovering over the Nepalese power sector. Nevertheless, recent years have witnessed hopes on the horizon with numerous hydropower projects above 3000 MW being under construction from the private sector after signing power purchase agreements with Nepal Electricity Authority. The PPAs with regard to hydropower projects in different river basins have already crossed 4000 MW and many developers in long queue with the potential of 6000 MW-plus are awaiting PPAs to be signed.

As per the simulation-based power scenario, Nepal is capable of supplying power to India in the wet season of FY 2018/19 and the years onward which can be banked to India and regained after some months in dry season. Besides this ongoing fiscal year requiring energy banking and import to fulfill the domestic demand of the country, the transaction between Nepal and India may be characterized by both energy banking and export for some years up to 2025/26 as the dry season deficit is less than the wet season surplus in these years. However, Nepal will be a power exporting country without need of banking after this period if all the hydropower projects planned and proposed including those under construction are commissioned as per the timeline given in the White Paper published a few months ago by the Ministry of Energy, Water Resources and Irrigation, Government of Nepal.

The seasonal complementarities of demand and supply of electricity that exist in our two countries make energy banking a highly suitable model for power transaction at seasonal basis to benefit both countries.

2. Power Import from India

The history of power exchange between Nepal and India started with 5 MW of power import to Nepal in 1971. At present, Nepal has been drawing power from India in radial mode through various links at 132 kV, 33 kV and 11 kV voltage levels connecting the Indian States of Bihar, Uttar Pradesh and Uttarakhand with Nepal under Power Exchange (PE) mechanism. The existing interconnections between Nepal and India are as follows wherein only two interconnections, Dhalkebar- Mujaffarpurand Tanakpur-Mahendranagar,are undergoing power flow through power trading companies and the rest of them are associated with PE mechanism. After the construction of Dhalkebar-Mujaffarpur 400 kV cross border transmission line, Nepal and India are now undergoing deliberations to finalize the implementation and funding modality for the second 400 kV cross border line, New Butwal- Gorakhpur (New).

Also, after Nepal and India signedthe Power Trade Agreement (PTA) on October 21, 2014, Joint Working Group (Joint Secretary level) and Joint Steering Committee (Secretary level) meetings are taking place regularly to deal with the issues of cross border connectivity and power trading between the two countries.

The existing interconnections between Nepal and India are as follows:

Interconnections	Voltage Level (kV)	Import Power (MW)
Kataiya – Kusaha	132	125
Kataiya – Rajbiraj (Under Kosi Agreement)	33	10
Sitamadi-Jaleshwor	33	12
Raxaul-Birgunj	33	12
Ramnagar-Gandak	132	25
Jaynagar-Siraha	33	7
Nanpara-Nepalgunj	33	12
Tanakpur-Mahendranagar	132	30
Dhalkebar-Mujaffarpur (to be charged at 220 kV and then finally at 400 kV)	132	120
Kataiya – Kusaha II	132	50
Raxaul-Parwanipur	132	50
Jhulaghat (0.6MW), Jaulijibi (0.1MW), Lali (0.1MW) and Huti (0.1MW)	11	0.9
	Total	**453.9**

3. Rationale for Energy Banking

Nepal's power generation is predominantly hydro-based. Most of these hydropower plants are run-off-River (ROR) type. They generally generate energy in full capacity, i. e., 70-85% of total annual energy, in its wet/monsoon season which normally lies from May to October, whereas the load is not high in Nepal in these months and it will lead to the seasonal power surplus situation in Nepal after one or two year(s) if the current scenario as per the load forecast continues without policy intervention.

However, the electricity demand in various States of India like UP, Hariyana and Punjab is quite high in India during the same period by virtue of high agricultural and cooling loads in these States. Nepal can supply power to India during these months and it will also serve the purpose of generation mix of hydro, solar and thermal power to some extent.

Similarly, power can flow in reverse direction from India to Nepal in dry season of the year during which Nepal's electricity demand is high, but hydropower generation is drastically diminished to almost one third of the installed capacity of a ROR hydropower plant due to low discharge in rivers. It makes power import from India an inevitable option for Nepal for balancing demand and supply of electricity as Nepal does not have enough reservoir hydropower capacity right now. As such, the deficit of power and energy in dry months in Nepal can be met through the transaction of the power from India to Nepal in lieu of the power supplied to India by Nepal in the wet months under energy banking mode.

Both the countries can benefit from this transaction through energy banking by virtue of seasonal complementarities of demand and supply of electricity and it will allow the optimal utilization of our resources in terms of both generation and transmission capacity of existing facilities.

4. Earlier Understandings and Deliberations

India-Nepal 10th Power Exchange Committee (PEC) meeting held in December 2011 in New Delhi had already paved the way for selling surplus energy of Nepal, if any, to India.The minutes of the PEC meeting states:

"NEA should approach BSEB (now BSPHCL) and mutually decide the matter if NEA has some power to export to BSEB during the months from July to October and wants BSEB to procure this power under power exchange mechanism."

This provision of power import and export with the same tariff applicable has virtually established the principle of energy banking mechanism between Nepal and the Indian state of Bihar.

Energy banking issue as requested by Nepal side was discussed again in the meeting between Bihar State Power Holding Company Limited (BSPHCL) and NEA at Patna, India on April 25, 2017. It was agreed as follows in the Minutes of Meeting:

"NEA officials requested that power import from Nepal to India during wet or monsoon season along with proposal

for banking of power can be explored on mutual interest. BSPHCL agreed it in principle. However, issue needs further detailed deliberation /examination. Both NEA and NBPDCL officials maintained that the issue deliberated in the meeting will be examined."

The 11th PEC meeting held on August 8, 2017 in New Delhi, India, discussed and minuted this issue of power transaction through energy banking as follows:

"The Nepal side proposed for the transaction of power between India and Nepal through energy banking mechanism in future for which Bihar side also expressed their interest. However, since the detailed proposal was not placed before PEC, it was agreed that Nepal would put up the matter with detailed agenda for deliberation in the next JSC/JWG meeting."

The 5th JSC meeting held on April 17, 2018 in New Delhi, India, discussed and minuted this issue of power transaction through energy banking as follows:

"Indian side stated that the energy banking concept may involve discussion with Indian states and detailed analysis of power scenario, tariff, etc., in different seasons for both seller and buyer. It was agreed that CEA and NEA would study the proposal/issues involved in exchange of power through energy banking."

This issue of energy banking was deliberated in the meeting between CEA and NEA in New Delhi on July 5, 2018 as mandated by the 5th JSC meeting and it was decided that the guidelines for energy banking between the two countries would be frameworked by taking some inputs from the different Indian entities which have experiences of this sort of transaction.

5. Simulation-based Bankable Energy

The power scenario presented herein is based on the new demand forecast of NEA. The GDP growth is considered to be 7.2% and the load factor is taken as 60%. Further, supply for the first five years is based on the committed hydropower projects which are under construction and, in the years afterward, it is based on the proposed projects including the reservoir ones.

In addition to the base case scenario, an optimistic case scenario is presented by incorporating the following projects as mentioned in the White Paper published by the Ministry of Energy, Water Resources and Irrigation. The list of these projects is as follows:

Projects	Capacity (MW)
Beganas Rupa Pumped Storage	150
Phukot Karnali	500
Arun 4	400
Lower Arun	400
Kimathanka Arun	450
Nalghat	410
Naumure	245
West Seti	750
Sunkoshi 3	536
Kokhajor	111
Sunkoshi 2	1110
Siwalaya (Thosne) - Khimti	500
Total Capacity	**5562**

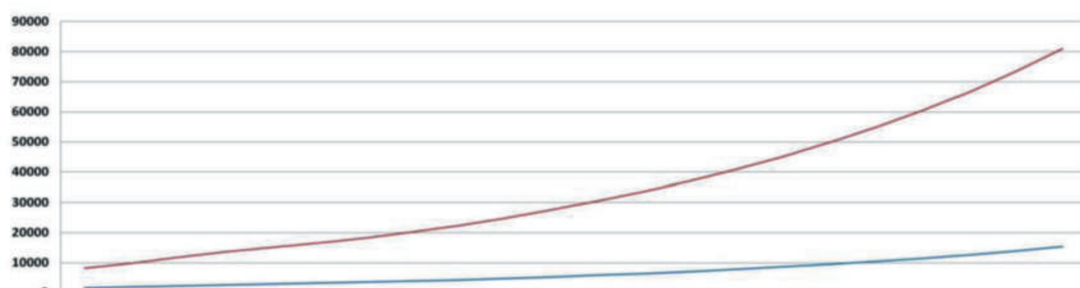
The load forecast of Nepal for 22 years and the quantum of energy that can be banked with India are shown below in the first and the second graphical representations respectively:

6. Energy Banking Arrangements

Some major features of energy banking based on the practices among the Indian entities are summarized below:

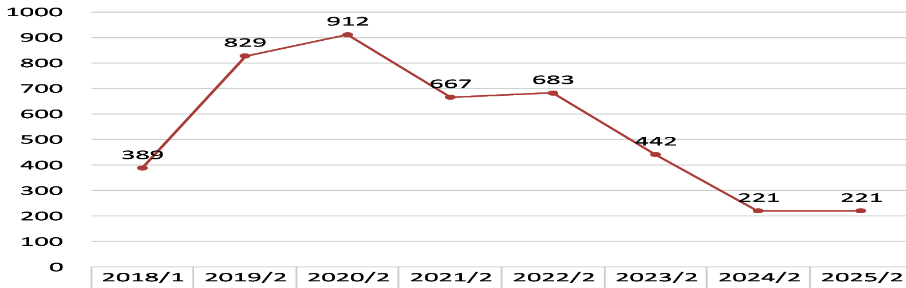
- Two entities/utilities enter into swap agreement to utilize the seasonal variation in their load patterns.

Load Forecast of Nepal



	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31	31/32	32/33	33/34	34/35	35/36	36/37	37/38	38/39	39/40
System Peak (MW)	1566	1892	2243	2603	2861	3148	3467	3841	4259	4727	5246	5821	6411	7065	7791	8599	9496	10451	11509	12681	13979	15417
Total Generation Requirement (GWh)	8230	9943	11787	13684	15038	16545	18222	20189	22388	24845	27571	30596	33695	37133	40951	45194	49909	54931	60492	66651	73473	81032

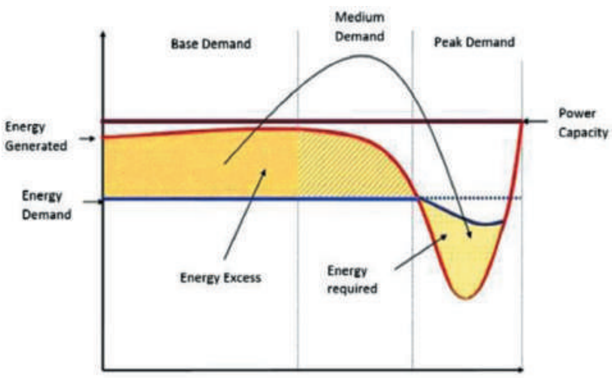
Energy Banking Quantum



	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
Base Case Scenario (GWh)	389	829	912	667	683	442	221	221
Optimistic Case Scenario (GWh)	389	829	912	667	683	442	221	221

Data source: System Planning Department, NEA

- The concept of energy banking may be illustrated as follows:



- Forward banking entity/utility returns the banked energy to the other entity/utility with some agreed premium.
- The transaction is undertaken directly between two entities/utilities or through a power trader primarily on negotiation basis.
- There is a need of transparent guideline for energy swap arrangement.
- The banking arrangement is done wherein two entities/utilities swap energy to match their seasonal variations in surplus and deficit situations.
- It is a cashless,energy-for-energy transaction wherein no tariff is applied for the energy banked or returned.
- In addition to the open access charges to be paid by the banking entity (That is, NEA, in this case), the transmission charges and losses to be borne -

  (i) by energy banking entity when energy is supplied to returning entity and

  (ii) by returning entity when the energy is returned to banking entity are as follows:

  - Injection losses & charges of the injecting point
  - State Transmission Utility (STU) transmission losses and charges, if any
  - SLDC (State LDC) Scheduling charges and concurrence charges, if any

- The transmission charges and losses to be borne -

  (i) by energy returning entity when energy is supplied to returning entity and

  (ii) by banking entity when the energy is returned to banking entity are as follows:

  - Withdrawal losses & charges of the withdrawal point
  - State Transmission Utility (STU) transmission losses and charges, if any
  - SLDC (State LDC) Scheduling charges and concurrence charges, if any

- Any deviation from the approved schedule will have to be paid by energy banking or returning entity as applicable as per the frequency-based Unscheduled Interchange (UI) / Deviation Settlement Mechanism (DSM) rate.
- After completion of the transaction, an entity is required to prepare final energy account showing the energy banked and returned in terms of million units (MU's).
- No financial settlement is required if both of the entities involved perform their respective obligations and are in agreement to carry forward the balance energy to a mutually agreed period.

- If the quantum of power returned by the returning entity is less than the agreed quantum returnable, it will have to pay the banking entity for the shortfall energy at the rate already agreed upon.
- If the quantum of power returned by the returning entity is more than the agreed quantum returnable, the other entity will have to pay the returning entity for the excess energy at the rate already agreed upon. This rate may be different from the rate payable by the returning entity in case of the shortfall energy.
- There may or may not be trading margin for the transaction depending on the agreement between a trading company and the banking entity in case a trading company is involved in the energy banking.
- In the diagram below,

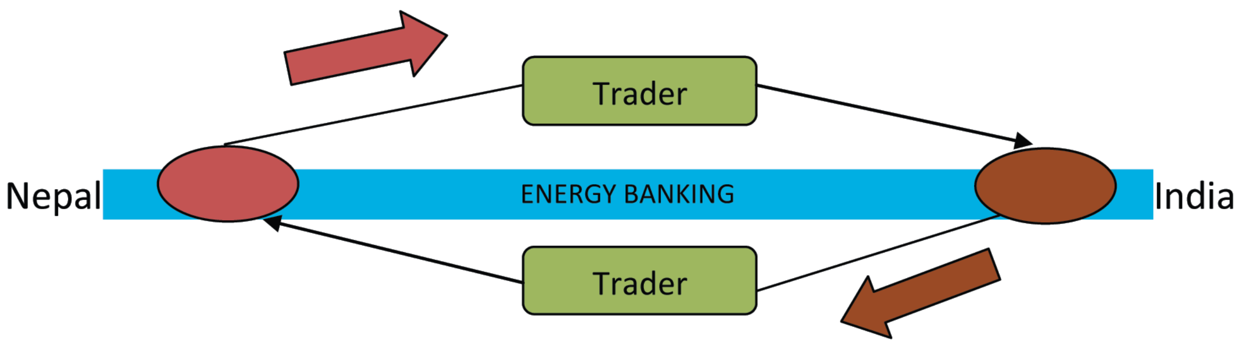
Upper half: Nepal banks energy to India through a trader or directly.

Lower half: India returns energy to Nepal through a trader or directly.

7. Conclusions

In normal circumstances, there are large prospects of energy banking between Nepal and India as this is a rich and full agenda to pursue, awaiting policy decisions followed by liberal guidelines. Given the influx of hydropower licenses and PPA applications from the private sector, the future for electricity in Nepal looks panoramic from the perspectives of gaining independence in it and increasing the level of cross border power exchange. In fact, energy security of Nepal thrives on bilateral / sub-regional market integration and Government motivations are quite meaningful in this entire process.

Energy banking which is basically energy-for-energy transaction between two entities can be considered as an important tool of energy cooperation between Nepal and India by virtue of seasonal complementarities of demand and supply of electricity existing in these two countries and its role to save Nepal's seasonal imbalance of power from being chaotic by strong dominance of ROR hydropower projects in the system.



- Banking arrangement 'A' and returning arrangement 'B' may be specified in the following ways:

Arrangement 'A': Quantum of power to be banked by Nepal in wet season

Entity	Period (From dd/mm/yyyy to dd/mm/yyyy)	Duration (From. Hrs to Hrs)	Quantum (MW)	Delivery Point
Nepal				

Arrangement 'B': Quantum of power to be returned by India in dry season

Entity	Period (From dd/mm/yyyy to dd/mm/yyyy)	Duration (From. Hrs to…Hrs)	Quantum (MW)	Delivery Point
India			-- % of banked energy	

Nepal Electricity Authority has already signed PPAs with Independent Power Producers for the capacity of about 4300 MW and more than 6000 MW hydropower projects are in process for PPA, most of them being RoR type. If we cannot sell all energy produced from these projects in wet season at Probability of Exceedence (PoE) of Q40 to our consumers, huge financial losses to NEA will be incurred not only due to the Take-or-Pay provision of the respective PPAs but also due to the increased power import cost for having to purchase the energy in dry season from the Indian States at high PEC tariff. This problem can be sorted out through the banking of energy with India in wet season and getting it returned in dry season characterized by reduced hydropower generation. Also, dry season higher tariff provided to the hydropower generators of Nepal as of now will lose justification for the huge disparity with regard to the wet season tariff when the wet season energy can be supplied to the consumers through energy banking in dry season.

Through energy banking in practice, the utilization of cross border transmission lines can be enhanced and there will be no need to restrict PoE to Q40 as per NEA's current policy for ROR and PROR hydropower projects while finalizing power and energy for PPA because higher generation in wet season will virtually be transferred to dry season through the mode of energy banking. In this way, energy banking may be considered analogous to the function of a reservoir project storing water during monsoon period and using it to generate power in low-discharge period of the Nepalese rivers. In other words, it is something like, virtually though not physically, changing ROR and PROR hydropower projects into storage projects without adding any infrastructures and storing water.Of course, it will lead us to think and rethink of designing and operating low-Q ROR/PROR projects from the perspective of energy banking and using storage projects to export energy particularly during the period when the energy tariffs are high in the market, thereby enhancing the economic use of water stored or wasted.

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नेपाल विद्युत प्राधिकरण उपदानकोष व्यवस्थापन तथा सञ्चालन कार्यविधि, २०६५

यस कार्यविधि अनुसार कुनै पनि कर्मचारीले अनिवार्य अवकाश पाउनु अगाडी राजिनामा स्वीकृत गराई सेवाबाट अलग भएमा वा भविश्यमा प्राधिकरणको सेवाको निमित्त अयोग्य नठहर्ने गरी सेवाबाट हटाईएको अवस्थामा प्राधिकरणबाट थप भएको रकम र सो को ब्याज मध्ये देहाय अनुसारको दरले उपदानकोष रकम भूक्तानी पाउनेछ।

सेवा अवधी	अवकास प्राप्त ब्यक्तिले पाउने रकम	कैफियत
५ दखि १० बर्ष	जम्मा भएको रकमको ५० प्रतिशत र सोको ब्याज	ने.वि.प्रा.को तर्फबाट जम्मा भएको
१० दखि १५ बर्ष	जम्मा भएको रकमको ७० प्रतिशत र सोको ब्याज	ने.वि.प्रा.को तर्फबाट जम्मा भएको
१५ दखि २० बर्ष	जम्मा भएको रकमको ९० प्रतिशत र सोको ब्याज	ने.वि.प्रा.को तर्फबाट जम्मा भएको
२० बर्ष वा सो भन्दा बढी	जम्मा भएको रकमको १०० प्रतिशत र सोको ब्याज	ने.वि.प्रा.को तर्फबाट जम्मा भएको

तर कर्मचारीले निजको तर्फबाट कट्टा गरेको १० प्रतिशत रकम र सो को ब्याज, कर्मचारी जुनसुकै किसिमबाट सेवाबाट अलग भए पनि १०० प्रतिशत नै भूक्तानी पाउनेछ।

Discussion Application of Liquidated Damages and Contract Execution

Subhash Kumar Misra
Chief, Kulekhani III Hydro project, NEA

Abstract: *Prevailing legal/contractual provisions on contract time extension, application of liquidated damages (LD) and contract execution situation after LD application are reviewed. The dichotomy between the application of LD and contract execution situation thereafter are analyzed.*

Introduction

Liquidated damage (LD) is a pre-defined maximum compensation amount agreed in a contract to be paid to the non-breaching party by the party breaching the contract (Section 83 (2) of Contract Act, 2056 of Nepal (NCA)). It is a kind of remedy that can be exercised by the affected (injured) party in the contract.

In the procurement contract, is standardized as a form of compensation to be paid by the contractor to the employer [Rule 121 (a) of Public Procurement Rules (PPR), Regulation 199 (a) of NEA Financial Regulations (NFR), FIDIC conditions of contract whereas the provision of compensation to be given by the employer to the contractor is provisioned in other forms such as granting extension of time (EoT), payment of reasonable claim amount, etc. In the context of procurement contract the application of LD is a consequence of breach of contract because the breaching party could not complete its obligations under the contract within the agreed deadline (breach of contract: NCA Section 82(1)).In the perspective of such contract breach, the application of LD basically forms the ground for the contract termination and, therefore, issuing EoT is out of question.

Necessity of contract execution after the application of LD

Circumstances arise when the works under the contract needs to be completed by the same party (contractor) even after the application of LD. This is because the purpose of the contract might be pushed into further uncertainty if the contract is terminated once the LD is applied. Such circumstances are common in case of construction contracts involving complex structures/systems such as hydropower projects, transmission line projects, etc. Depending upon the stage of physical progress and other crucial factors, the completion of such complex systems might face the risk of further delay in case the contract is prematurely terminated. For these reasons, provisions are made in laws/regulations/standard conditions of contract that the breaching party shall not be relieved from its contractual obligations even after compensating the injured party by paying LD [PPR 121 (b),NFR 199 (b), FIDIC conditions, etc]. In other words, these clauses give option to the non-breaching party to treat the contract alive even after the application of the LD.

Period associated with LD

It is a standard provision in the construction/procurement contract to recover the predefined amount of damage at a fixed percentage per day—generally 0.05% of the contract price per day [PPR 121 (a) and NFR 199(a)] not exceeding a maximum limit. This would,then,give rise to a time period—typically 200 days at the rate of 0.05% per day and for the maximum limit of 10% (let this period be defined as the Calculated Period). This condition, therefore, envisages that the contract in any case would conclude or the works under the contract would be complete latest by the end of this Calculated Period of 200 days. This is in line with NCA Section 83(4) which states that a time extension may correspondingly be claimed by the LD paying party in proportion to the damages paid. This means, the Calculated Period is well defined in the law and standard conditions of contract. No remedy is, however, envisaged in the standard conditions of contract or law if the works are not complete within the Calculated Period. It is not clear whether such situation will automatically lead to contract termination.

The Post-LD Contract Execution: A Dichotomy

Now the question arises how the execution period after the application of LD but beyond the Calculated Period would be defined ?

In this regard a question immediately comes to the mind: though not explicitly stated, will it not be an implicit extension of time (EoT) of the contract by letting the breaching party to continue and complete it in line with PPR 121(b) and NFR 199(b) ?If we consider it to be an extension of time, however implicit, then, this situation would be in direct contradiction with the fact that the party is in breach of contract and hence the LD is applied. This is because EoT is granted only for some well defined valid reasons (Section 56 of Public Procurement Act (PPA), PPR 120 and NFR198) in which the question of LD does not arise. Conversely, if we do not consider it to be an implicit then we cannot justify the post-LD contract execution. Furthermore, basic contractual provisions such as making payments for the works executed, etc., are continued to be followed when the contract is executed in line with PPR 121 (b) and NFR 199(b) after the application of LD. In other words, all the contract provisions are to be complied with, except for granting formal EoT, when the contract is to be executed with the same party after application of LD.

The above examination shows that there exists a dichotomy between the situations of application of LD and application of PPR 121(b) and NFR199(b). This dichotomy sometimes creates complications. For example, valid EoT is asked by authorities issuing working visas to the foreign personnel of the contractor which has breached the contract by not meeting the agreed time schedule and LD is imposed. To cite other examples: formal EoT is asked in the tax clearance process of the party (contractor), or in customs clearance process by the party while importing the goods to be used in the works under the contract. Many such occasions arise during execution. But the above dichotomy prohibits to issue formal EoTs and such complications aggravate the post-LD contract execution situation, and consequently, hampers the work progress.

From the above analyses it is clear that the post-LD contract execution the period beyond the Calculated Period, needs to be formally defined. This will help avoid the above mentioned complications. For this, the clauses PPR 121(b) and NFR199(b) may be supplemented with some clarifications. Such supplementary clause may be worded as follows by adding a new sub-clause (c) after (a) and (b):

" (c) the employer, if deems necessary, issues EoT beyond the period proportionate to the LD amount (Calculated Period) for some specific requirements during contract execution beyond such period without, however, violating the provision in (a) of this Clause or Regulation."

Conclusion

A clause supplementary to Public Procurement Rule Clause 121 (a) & (b) and NEA Financial Regulation 199 (a) & (b) seems required for restricted extension of time for specific requirements in case the contract is to be continued beyond the period proportionate to the applied Liquidated Damage amount. •

Variation in Construction Work

Surya Parsad Poudel
Deputy Manager, Project Development Department, NEA

Introduction

Variation (sometimes it is referred to as a variation instruction, variation order (VO) or change order) is an alteration to the scope of works in a construction contract in the form of addition, substitution or omission from the original scope of work. FIDIC defines the variation as increase or decrease the quantity of work included in contract, omission of work, change the character or quantity or kind of any work, change the level, lines position and dimensions of any part of work and change any specified sequence or timing of construction of any part of the work. In construction, variation is inevitable and every construction project encounters the variation in different forms. There are several reasons of variation in original scope of work which may occur from Employer, Engineer and Contractor.

In construction project, there are generally three parties; The Employer, the Consultant and the Contractor, involve in construction and they have contract for executing the particular work. The standard form of contract for large project in Nepal is FIDIC contract (Red Book for Item Rate Contract, Yellow Book for Design and Build Contract and Silver Book for EPC/Turn Key type of contract).

In construction project, the terms variation and claims are used frequently but they are entirely different. Sometime it is said that the contractor is claiming a variation, it means that contractor is making an application of variation. Any claim in respect of variation only occurs when Employer or Engineer rejects application and contractor disagree with the decision and wishes to pursue a claim. Claim may arise when Employer fails in his part to fulfill the condition of contract. The claim may also arise due to the outside events like force majeure and not foreseeable physical obstruction or condition which affects the contractor's work. The settled claims; extension of time or monitory compensation is ultimately a variation.

Variation to the original scope of work may change the entire scope of work. The contract usually provides the method that allows the Employer/Engineer to change the scope of work. The valuation of variation and basis of payment in respect of any variation to the contractor is also usually established in the contract. Depending upon the terms and condition of contract, Engineer/Employer evaluates and agrees the variation including assessment of compensation and time extensions.

Variation at large is quantity variation and addition of new items of work. Variations due to price adjustment for price escalation and other variation due to change in legislation etc. are not elaborated here. All types of changes ultimately result quantity variation, new items of works and cost variation. Valuation of variation in term of quantity variation based on FIDIC Red Book is rather simple than valuation of new items of work. New items of works are also valuated based on the contract but contract does not have proper guideline to finalize the new rates. For the public projects, the rates for varied items are generally proposed by contractor, reviewed by Engineer and approved by Employer. The approval of new rates from Employer is always in lower side, which is the main cause of contractor's disagreement and may ultimately form a dispute and claims. This paper intends to have general idea about variations and its valuation, dispute and settlement of dispute if it occurs and some experience gained from the public hydropower project while dealing with variations.

Contractual Aspect Of Variation

As per FIDIC Contract, when there are chances to vary the original scope of work, Engineer/Employer shall make variation and issue to the contractor. However, the contractor is not authorized to make any variation without approval from Engineer/Employer. The FIDIC Contract guides us how and who can issue variations, how variation is valuated, when can Engineer fix rates and what happens when variation exceeding 15% of contract price. The Contract also guides to issue daywork for varied work which shall be executed on a daywork basis. In FIDIC 1987 Red Book, Clauses 6.3, 6.4, 12.2, 20.4, and 40.1~40.3, 41.1~44.3, 69.1~69.5, 51.1 to 52.4,70.1, and 70.2 etc. are related to variation and adjustment: Alteration, Additions and Omissions etc. Similarly, In FIDIC 1999 Red Book, Clauses 13.1 to 13.8, 4.12, 8.8, 14.8, 14.15, 17.3, 19.1~19.4 etc. are related to variations and Adjustments.

Valuation Of Variation

Valuation of variation is generally performed by Engineer. It is to be noted that under FIDIC 1987, the Engineer was independent and acted as an adjudicator, when required to give an Engineer's decision under Clause 67. In New FIDIC Contract Edition 1999, the Engineer is not independent anymore and he acts as the Employer's agent. However, Engineer is supposed to do fair evaluation of variation. In FIDIC 1987 Contract, Clauses 51.1 to 52.4 are related to variation and valuation of variation. Clause 52.1 states that the varied work shall be valued at the rates and prices set out in the contract if, in the opinion of the Engineer, the same prices shall be applicable. If the contract doesnot contain any rates or price applicable to varied work, the rates and price in the contract shall be used as basis of valuation of varied work (pro rata to the contract rates or prices). The Engineer has to consult to both Contractor and Engineer at time of valuation of varied work. If Contractor and Engineer agree on suitable rates or prices in presence of Employer, than these rates and price shall be taken as final rates and prices as per contract and Engineer may use these price to evaluate variation. In the event of disagreement between Contractor and Engineer, Engineer may fix rates or prices which shall be reasonable in opinion to Engineer and shall notify the Contractor and Employer. The Engineer can use the rates or prices fixed by him to determine the provisional prices to enable on account payment to be included in certificates issued in accordance with payment Clause.

When Engineer fixes prices for varied work, Engineer has to take approval from Employer as per provision of Contract, Engineer's duties and authority. In practice, when variation is instructed, Contractor generally submits his rates for varied work with his substantiations. Engineer review it and correct it if necessary as per his substantiation and provision of contract. If Engineer's rate is lower than contractor's rate, than Engineer invite contractor stating that the rate proposed by contractor is not substantiated by him, therefore Engineer has to correct the rate as per his substantiation. If Engineer and Contractor agree on the Engineer's rate, than rate is final otherwise Engineer will use his rate for pricing for on account payment. The Engineer than make comprehensive variation report or may send individual rate with detail breakdown of rates and necessary substantiation to Employer for review and approval. If Employer approve that rate than rate will be final, but if Employer don't agree the Engineer's rate and alters the rates than dispute arises and dispute may ultimately be solved through arbitration or litigation.

One of the major causes of dispute is the valuation of variation and understanding of rates from contractor, Engineer and Employer. The Contractor generally demands high rate, Engineer determines the balance rate, Employer approves lowest rates for those items which are new. As per FIDIC 1987 contract Clause 52.1, if Engineer and Contractor agree the rates or prices, in presence of Employer, of varied work, rates or prices are said to be final. However, practically, Only Engineer and Contractor cannot finalize the rates or price because of contractual provision that the Engineer has to get approval from Employer for those rates agreed with Contractor. The Employer may not grant approval to Engineer for those rates or prices as agreed between Engineer and Contractor. If Employer decrease the rates or prices than dispute may certainly arise. This kind of arrangement in Contract is the main cause of dispute in the valuation of variation. Once dispute arises, it may follow the dispute resolution process. Such type of dispute sometime causes severe disruption to project as Contractor may suspend/slowdown the work saying that suitable rates or prices for varied work are not provided to him.

In Chameliya Hydropower Project, variations such as quantity variation, new item of work were encountered during execution of work. Quantity variations had been evaluated at the rates contained in contract. Variation, for which rates or prices contained in the contract cannot be applied, new rates have been determined based on the contract. Sometimes, If Engineer and contractor do not agree on new rates, Engineer has fixed the rates as per contract and inform to Contractor and Employer for determining on account payment to the Contractor. All the variations related to new items of work; none of them have been finalized. The Contractor has referred all the variations issues to DRB or Arbitration saying that the rates approved by Employer cannot be accepted.

Variation Exceeding 15 Percent

In FIDIC 1987, Condition of Contract, Clause 52.3 is provisioned for variation exceeding 15 percentages.It is stated that "On the issue of Taking –Over Certificate for the whole of the work, if it is found that: all varied work valuated under Clause 52.1 and 52. And all adjustment upon measurement of the estimated quantities set out in the Bill of Quantites excluding provisional sums, dayworks and adjustment of price made under clause 70, there have been addition to or deduction from the Contract Price which taken together are in excess of 15 percent of the "Effective Contract Price" (Contract price excluding provisional sum and allowance of daywork), after due consultation by the Engineer with Contractor and Employer, there shall be added or deducted from contract price such further sum as may be agreed between the Contractor and Engineer, failing agreement determined by Engineer having regard to Contractor's site and general overhead cost of the contract". It means that for variation exceeding 15 %, Engineer has to add to or deduct from contract price an overhead of contractor by certain amount. The understanding of clause is for variation exceeding 15%, the overhead of the contractor is not like overhead for quantity below 15%. The overhead shall be decided between Engineer and Contractor not from contract. The Clause is totally silent how and how much extent that amount has to be added to or deducted from contract price. It is another cause of dispute as Contractor may re-rate the varied work and Engineer and Employer may not agree on that.

In FIDIC Conditions of Contract, there is no special Clause regarding variations exceeding. The Parties shall agree on variation exceedings issue among them. Excess of 15 percent of the "Effective Contract Price" in Sub-Clause 52.3 of FIDIC General Conditions of Contract is regarding not paying general expenditure to the Contractor for the variations exceeding above 15 per cent as included in approved BOQ. Thus when variations exceed 15 per cent, taking into account Site and general overhead costs, the Contractor shall be paid according to the determined sum. Otherwise the Contractor shall not make any request. FIDIC Conditions of Contract are available, regardless rate, for the approval of variations exceeding by Contracting Authorities. However,In FIDIC Edition 1999, the provision of variations exceeding is very clear in clause 12.3. In FIDIC 1987, if variations exceeding as per clause 12.3, it is stated that new rates shall be provisioned how new rates are determined it is also not so clear.

Daywork

In FIDIC 1987, Engineer may, in his opinion it is necessary or desirable, issue an instruction that any varied work shall be executed on day work basis. Generally, therates for day work basis have been included in day work schedule in contract. The Contractor shall be paid for such varied work under the terms set out in the day work schedule included in the Contract and rates and prices affixed there to.The Contractor shall submit all the necessary substantiation of his work detail to Engineer for certification of day works. The valuation of variation on day work basis is rather simple than other method of valuation.

Dispute

A contract dispute occurs when any party in a contract has a disagreement regarding any of the contract terms or definitions. In contract law, a contract dispute is usually considered a breach of contract, meaning that a party failed to perform a duty or promise that they agreed to in the contract. There are two different types of contract breaches: Material Breach and Minor Breach.

Material Breach: A material breach in a contract occurs when a party fails to perform a contractual duty and the breach is so crucial and deep that it makes the agreement or purpose of the contract irreparable. Usually this occurs when the heart of the contract is not satisfied because of the breach. When a material breach occurs, the non-breaching party does not have to perform their end of the contract and can sue the breaching party in return for any damages caused by the breach.

Minor Breach: A minor breach occurs when there is a breach of contract by a party, but the breach is very minor and does not disrupt the heart of the contract. When minor breach occurs, both parties must still carry out the remainder of the contract, but the non-breaching party may sue for damages.

In construction Contract, variation is one of the major sources of dispute between contractor and Employer. There are mainly three types of dispute in relation to variation: payment for variation, valuation of variation and quantity measurement for variation.

Valuation Of Variation

In FIDIC Contract, Engineer is authorized to evaluate variation and if all parties agree, then rates and prices become final. In practice, Engineer and Contractor may agree on rates but Employer may not agree on these rates. After finalizing the rates, Engineer submits the consolidated variation report to Employer with his substantiations. Employer may agree on the rates and prices contained in contract, but for new rates, Employer sometimes intentionally alter the rates or prices citing several reasons. When Contractor get the rate lower than what he agrees with Engineer, it will trigger dispute to valuation of variation. If Employer alters the rates or prices other than as agree between Contractor and Engineer, it is also the breach of contract as Condition of Contract does not stated expressly the Employer also has to agree on rats or prices finalized between Engineer and Contractor despite the fact that Employer should be satisfied on rates or prices which have been finalized between the Engineer and Contractor. This kind of breach of contract may be minor breach or it may be material breach depending on extent of variation.

Payment For Variation

In FIDIC Condition of contract, Engineer is authorized to increase or decreased the amount over contract amount by certain amount as specified in appendix to bid. If variation in that particular project is so large that the ceiling amount provided to Engineer cannot cover the varied amount, Employer sometimes may create dispute over provisional amount certified by Engineer which may result nonpayment of variation. In this context, Contractor may lodge a claim against Employer for breach of contract.

Another issue of payment of variation is the used up of the approved contract amount due to varied amount payment. Sometimes, due to variation in large extent, Contract amount and revised contract amount may exhaust due to payment of variation. Employer may not have approved budget for payment to varied amount. However, contractor may not agree with employer citing the clause of contract for nonpayment, which ultimately caused dispute due to breach of contract. The breach of contract due to nonpayment of certified amount to contractor, sometime affects the work severely to the extent to terminate or suspend the work.

Measurement Of Quantity

In FIDIC 1987 Red Book Contract it is expressly stated that “The quantities set out in the Bill of Quantities are the estimated quantities for the works and they are not to be taken as the actual and correct quantities of the works to be executed by the contractor in fulfillment of his obligations under the Contract”. In Red Book Contract, quantities and rates are constant only for that estimated quantities if there shall be no variations. If there is variation in quantity or new items of work, none of these quantities and rates shall be taken fixed. FIDIC Red Book Contract is re-measurement contract where contract quantities are only for purpose of determining the estimated cost. So, Variation in quantity is inevitable in Red Book Contract as Employer carries risk of contract amount increase. The Contractor execute the work, Engineer make re-measurement for that work for quantity and determine the price of executed work. If quantity exceed by certain percentage, new rates shall have to be determined. There will be several disputes while making the measurement and payment to the contractor if variation of quantity occurred in contract. The final amount is only determined when work is finalized, before that all the quantities, prices and amount are only for estimation. It is to be noted that all the interim payments paid to the contractor are only provisional not final, it can only be said final after defect liability period of the work where Contractor has to submit final statement and Engineer has to issue the final certificates as per contract.

Settlement Of Dispute

There are basically two type of dispute resolution method in commercial contract; Legal dispute resolution and extrajudicial dispute resolution. Legal dispute resolution, also refers court system Judiciary body, involves the courts and tribunal which is also called litigation (district court, appellate court, Supreme Court). On the other hand, extrajudicial dispute resolution which is called alternative to court system or ADR (Alternative Dispute Resolution) Method which involves, not limited to, prevention, negotiation, mediation, conciliation, neutral evaluation and arbitration. Arbitration is usually used for the final resolution of commercial dispute in the construction contract. However, In Nepal large commercial disputes in large Engineering Projects have only been settled by litigation.

If dispute is not settled between the parties amicably, either party is free to choose legal dispute resolution or Alternative dispute resolution methods.It is worldwide practice that Commercial disputes are being settled through ADR (especially arbitration) rather through court because of lengthy court procedures and piling of a number of cases in the court. Nepal has made first arbitration act, 2038 and now it is replaced by Arbitration Act 2055. The arbitration can be commenced during execution of work or after completion of work. The award of arbitration is binding according to the disputing parties' agreement and the law of arbitration. The parties have to obey the award as a verdict of court of low. Generally awards of arbitration are not voidable and even the court cannot make them void. In case of any challenge in the court against awards, any dissatisfied party may apply to appeal court (to make the award void) within 35 days from the date of award or day of the notice of award is received.

Recommendation

Variations in construction projects are inevitable due to condition of contract and complex nature of work. We need to choose or make the standard condition of contract which has easy tools to deal with variation. When variation occurs, its evaluation has to be done with substantiation and agreeable to parties which result less disputes. Variations are not corruption. It is the outcome of the condition of contract and complex nature of work where exact quantities and prices cannot be determined during tendering stage. The Engineer has to play a role as independently as practicable to evaluate the variations and Contractor also has to be responsible to submit his substantiation with his quotation. All parties should be responsible in their position while dealing with variation so that less dispute arise and result in timely completion of project even after large variations. If dispute occurs between the parties, contractual procedures have to be followed to solve it without disrupting the works.

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River Diversion Scheme of Hydroelectric Projects

Surya Nath Bhurtel
Deputy Manager, Middle Bhotekoshi, NEA

Introduction

Hydroelectric Projects consist of various hydraulic structures from Headworks to tailrace outlet. Every structure of hydroelectric projects are equally important and have their unique requirement and function. The river diversion structure is constructed to facilitate the construction of dam, spillway and intake. Generally, river diversion structures have no role after completion of the project. But, river diversion structure greatly affects construction duration of hydroelectric projects.

River Diversion

River diversion structure is the temporary structure constructed for diverting the river flow to facilitate the construction of Dam and associated structures. Generally, underground diversion tunnel is constructed for river diversion. The main purpose of the diversion structure is to divert the river water to ease construction of structures which fall in the watr-way.

River diversion can be carried via Diversion tunnel, Diversion canal, Diversion conduit etc. depending on the site conditions. The main components of river diversion are Diversion tunnel or canal, upstream cofferdam and downstream cofferdam. Cofferdams are required to divert the flow towards the diversion tunnel or channel.

Cofferdams

Cofferdams are generally temporary structures used to divert water from an area where permanent structures needs to be constructed. Generally upstream and downstream cofferdams are provided to divert the flows at the inlet and outlet of the diversion tunnel/channel.

Cofferdams are constructed from earthfill material, rock fill materials, concrete backfill or sometimes from sheet piles or bore piles depending on the site condition.

A cofferdam involves the interaction of the structure, soil and water. The loads imposed include the hydrostatic forces of water, as well as the dynamic forces due to current and waves. The loads imposed on the cofferdam structure by construction equipment and operations must be considered, both during installation of the cofferdam and during construction of the structure itself. Removal of the cofferdam shall be carried after the completion of the main dam intake and spillway. Cofferdam is subject to scouring, therefore the bed of the cofferdam must rest on rock or its bed needs to be grouted to protect from scouring and to stop seepage of water.

Cofferdams facilitate the construction of main dams which are generally constructed during the dry season. Generally, it facilitates the construction of main dams from November

Jet grouting at the Cofferdam of Madhya Bhotekoshi HEP

to June when the discharge of the river is minimal. During the rainy season, the cofferdam can be overtopped and hence the construction works needs to be halted. But after gaining the height of dams beyond the high flood level, the construction of dam and spillway can be continued during the rainy season also. As cofferdams are temporary structures, they are designed only for high floods having return period of 20 years.

Advantages of Cofferdam

Construction works performed in water ways has always been more difficult and costly than performing the same work elseware. The work performing water leads to much more difficulties and the cost of construction will be increased drastically. The main function of cofferdam is to make the construction site which lies in the water-way, temporarily water-free during construction period.

Cofferdam is constructed from earth fill, rock, concrete, timber or by sheet piles depending on the site condition. Selection of type of Cofferdam depends on available head of water, available construction material at site and possibility of overtopping by flood. For low head water, earth fill cofferdams can be used. If there is possibility of overtopping by flood, rock or concrete fill cofferdam can be used.

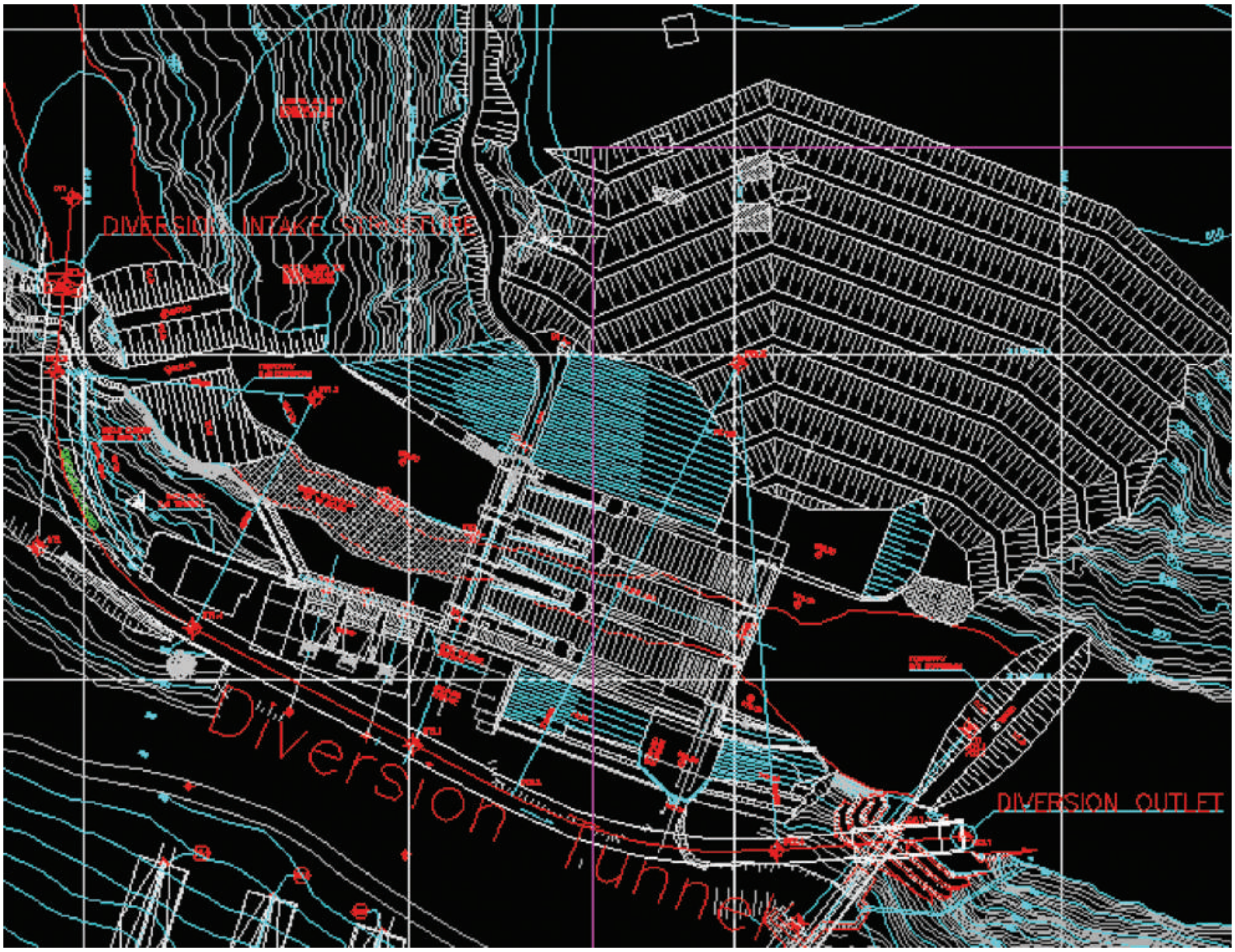
First stage of Cofferdam construction consists of construction of one bank of the dam structure during lean season flow and remaining part of the dam will be completed after the second stage of cofferdam on the next lean season flow of the year.

Capacity of Diversion Works

The capacity of river diversion scheme depends on the design flood. Larger the design flood, the size of the diversion scheme/structure will also be increased. Besides, if we choose less flood return period, the low height cofferdam may be subjected to overtopping. But, the design flood or the return period of flood corresponding to the minimum combined cost needs to be selected to design its optimum capacity. The selection of discharge capacity depends on the risk that cofferdam will face. As river diversion is temporary structure constructed during construction stage only, design flows of 20 years return period shall be taken for its design.

River Closure

River closure is considered as a very important milestone in hydroelectric project. River closure event is celebrated like a festival during the construction stage. For the river closure, it is necessary to stockpile all the needed materials



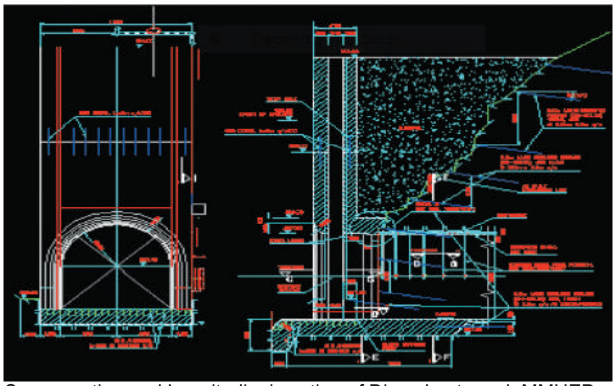
Plan of Diversion tunnel and Headworks, Middle Marsyangdi HEP(MMHEP)

on the stream bank. The height cofferdam needs to be raised to the required height. The dumping of material is carried on both banks rapidly by successive advances. The materials shall consists of big boulders, rocks and sufficient fine material shall create imperviousness. The remaining middle part of the river is closed rapidly by deploying more equipment at the same time, and then the river flow is diverted to the diversion tunnel/channel.

Some Examples of River Diversions in Nepal

River Diversion scheme was constructed in Middle Marsyangdi Hydroelectric Project (MMHEP) and Middle Bhotekoshi Hydroelectric Project (MBKHEP). The Middle Marsyangdi Hydroelectric Project consists of diversion tunnel of length of 375 m with concrete/shotcrete lined


River diversion of Middle Bhotekoshi HEP before and after diversion



Cross-section and Longitudinal section of Diversion tunnel, MMHEP

with face area of 63.6 sq. m. The upstream dam consists of Mass concrete dam with a crest elevation of 605 m and downstream cofferdam was constructed from earth rockfill dam. The design capacity of diversion flood is 560 cubic meter/sec., 135% of 20 years return period dry season flood. The diversion tunnel is useless after the completion of the project in 2008. It was concrete plugged in the center. But, now, bulk amount of sand has deposited just upstream of the inlet of diversion tunnel. There is a possibility of sand flushing occasionally from the diversion tunnel if the concrete plug is dismantled and stop-logsare installed in the inlet of Diversion tunnel.

The diversion tunnel of the Madhya Bhotekoshi HEP was complete and the river was diverted in on November 2017.

Conclusion

River diversion is very important in construction of hydroelectric projects as it is related with the construction duration of the projects.

Another good aspect of river diversion is that it can be constructed in the early stage of the project. In some projects, construction of diversion tunnel is started at the initial stage and bidding for the main construction works of the project is started in the next phase. The river diversion helps to minimize the construction duration by reducing the construction time for the dam and spillway. Ultimately, river diversion plays vital role in the early completion of the project.

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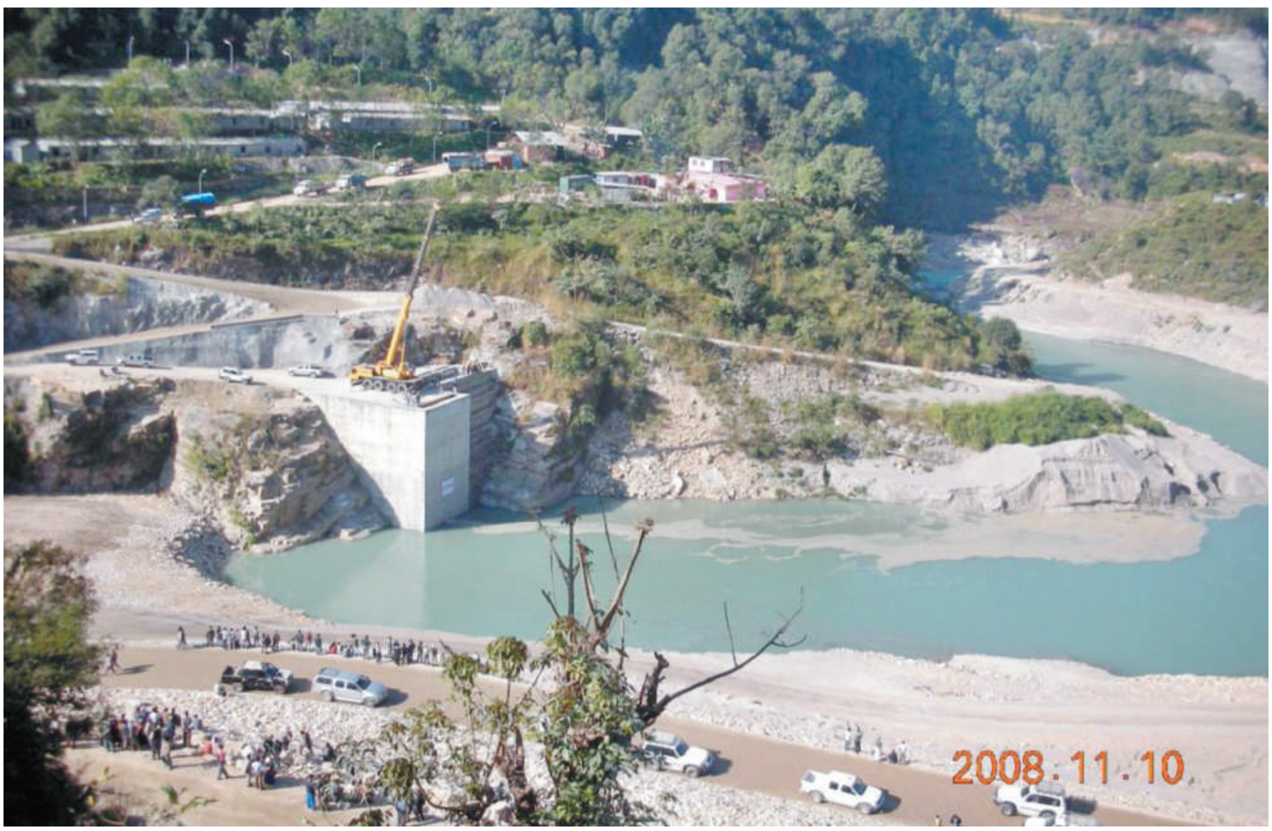


Diversion tunnel stop-log placing for reservoir impounding of MMHEP (Photo source: FJV)

Smart Meter Infrastructure

Manoj Kumar Shah
Deputy Manager, Planning and Technical Support Department, NEA

Smart meter is an electronic meter that reads and records consumption of electric energy by Consumer and other information and communicates frequently with Automatic Metering Infrastructure (AMI) System Software for monitoring and billing via various means of communication technology. Smart meters typically record consumed energy in different time interval as per requirement like 10 minutes, 30 minutes, 60 minutes or more frequently and report at least daily.

Like its' name, it has various smart functions for accurate and timely meter reading, monitor and control approved load of the consumer, balance amount of consumer if it is used in pre-paid mode, any fraud or electricity theft attempts and many more functions, including most or all of the following:

- Time-based Tariff Rate for Electricity Consumption
- Consumption data for consumer and NEA in real time mode for Monitoring
- Net Metering Facility to enable consumer to export surplus energy to NEA in day time via Solar PV or alternative source of electricity energy
- Loss of Power (and restoration) Notification
- Remote turn-on / turn-off operations of Meters
- Load limiting by inbuilt relay unit for excess consumption then approved load or negative balance amount or due to tampering on meter etc.,
- Energy Prepayment if meter is used in Pre-payment mode
- Power quality monitoring
- Tamper and energy theft detection
- Communications with other intelligent devices in the home
- Consumer can monitor electricity consumption and pay consumption bill amount via Online Payment Systems as available

And a smart meter is a green meter because it enables the demand response that can lead to emissions and carbon reductions. It facilitates greater energy efficiency since information feedback alone has been shown to cause consumers to reduce usage.

Smart Meter Communications Infrastructure

Smart meters communicate and send information to Automatic Metering Infrastructure (AMI) System Software via various means of communication technology for continuous interaction and exchange of information between the NEA, the consumer and the controllable electrical load. It must employ open bi-directional communication standards, yet be highly secure with encryption methodology. There are various communication architectures available to establish secure and robust communication between Smart Meter and AMI System. Some of the common communication architectures available and being used by Utilities are as below:

- Power Line Carrier (PLC)
- Copper or Optical Fiber
- Radio Frequency, either centralized or a distributed mesh
- Wi-Fi
- Zig Bee DNP Modbus
- GPRS/3G/4G

Nepal Electricity Authority (NEA) is using 3G Data Service from Nepal Telecom to connect around 10000 Time of Day (TOD) Meters and AMI System. The pilot implementation and testing work has been completed.

NEA is using two different type of communication system for Smart Meters. One is GPRS/3G communication data service for existing Commercial & Industrial (C&I) TOD Meters and Three Phase Whole Current Smart Meters. Smart Meters with GPRS/3G communication technology uses existing Telecom communication infrastructure to send and receive data to AMI System Server via TCP/IP protocol. NEA does not need to build and maintain its' own communication infrastructure in this type of Smart Metering System.

Another type of communication media is RF (Radio Frequency) based technology which is being used in a pilot project for Smart Meters inside Kathmandu Valley soon. The Radio frequency band being used for smart meter is 394-399 MHZ Spectrum. The RF (Radio Frequency) based technology needs Data Concentrator Unit (DCU), Routers, Repeaters to form RF Mesh Network with Smart Meters to send and receive data and information to AMI System. NEA needs to build and maintain its' own RF Mesh Communication Network Infrastructure in this type of Smart Metering System.

Automatic Metering Infrastructure (AMI) System

Automatic Metering Infrastructure (AMI) System Server installed at NEA Data Center contains web-based and secure Automatic Metering Infrastructure Software. The AMI Software has two different modules like, Meter Data Acquisition (MDA) or Head End System (HES) and Meter Data Management System (MDMS). MDA Server Software generally handles communication with Smart Meters to send and receive data from Smart meters. MDA Server also sends SMS and Email alert notification to concerned officials of NEA if there is any tamper or fraud attempt done with Smart meter. MDMS Server Software store and analyze the data being received from Smart Meters via MDA and generate various intelligent reports including Instantaneous Data, Load wise Consumption Data, Billing data and Tamper Data etc., The AMI Software Server is the core part of the Smart Metering System with various independent modules as required by NEA. The AMI System can provide web portal access to Consumer so that Consumer can also check their energy consumption details, billing details and other information whenever they need. There may be facility of Mobile Application for consumer services like monitoring, control, billing and payment collection via various payment services.

Instantaneous Report

This report is used to view the instantaneous parameters data of meters in real time mode. Smart Modem connected with meter will collect instantaneous data once in every fifteen minutes (which is fully configurable). Configuration is such that modem reads instantaneous data in every 15 minute and prepares billing data, load survey and events data which is called raw data of meter once in a day. During day change or after midnight 00:00 hours, it makes compressed files of both instantaneous and complete raw file and transfers into Meter Data Management (MDM) server. There is intelligent way of communication between meter and AMI Server to download meter data. If data download fails due to any reason, then modem will re-try and send only left over data to minimize the 3G/GPRS data service/communication charges.

FOTA (Firmware Over the Air)

NEA may need to read and change setting, configurations, time of day slot etc., of meters remotely via AMI Server. Any new firmware of meter can be upgraded remotely via AMI Server over the air. To update firmware, new firmware is to be copied / saved in the specific path in the AMI server. When AMI Server send firmware update command to the meter, it acknowledge or contact with the server path (path where firmware is saved) and enable transferring and updating new firmware over the air. After successful update of new firmware, meter checks all parameters to ensure new firmware works well and then it erases the existing firmware available in memory of meter.

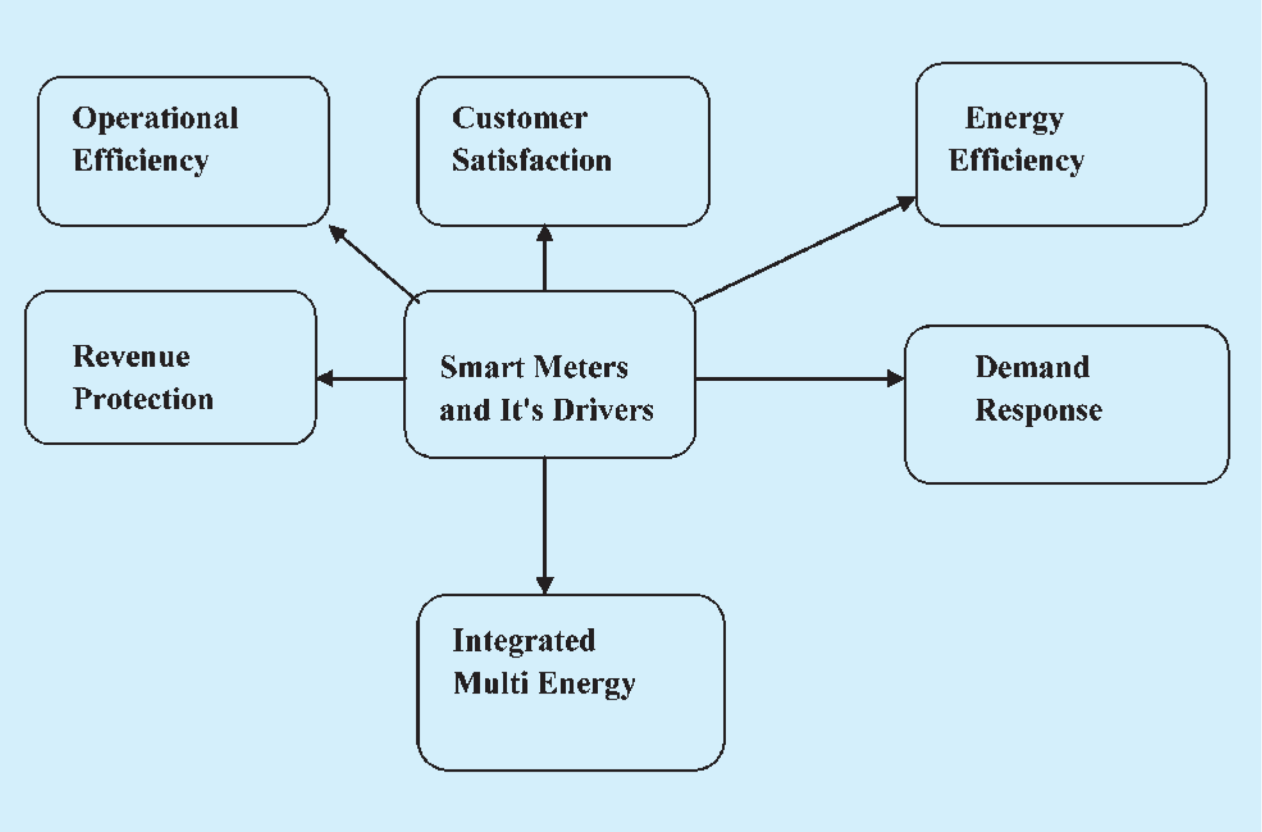
Meter Data Management System (Mdms)

- Meter Data Management System (MDMS) is a comprehensive web based software with rich features and reporting tools that helps electrical power distribution NEA / operators in monitoring & control, taking corrective actions, improving the overall energy distribution and billing and revenue system of the NEA.
- This system is basically a decision-support system for distribution operations, asset management and planning actions. It pinpoints poorly performing areas in the sub-transmission /distribution network, based upon the technical parameters, such as area wise distribution losses, theft, outages, overloaded circuits/equipment, voltage imbalance, reliability indices, power quality, consumption history and pattern of consumers etc.
- The system has capability to help in decision-making on network monitoring and upgrade actions by leveraging of historical meter data to calculate area wise load growth, equipment wise, downtime/outage statistics. It enables health and performance-monitoring and management of important system assets (feeders/transformers) and enables quicker event driven detection of HV/DTR outages thereby improving reliability indices and customer satisfaction and customer performance and usage pattern for long term and short term planning.
- This system remotely acquires meter data from the NEA system and selected consumer meters automatically, avoiding any human intervention, monitor important distribution parameters, use meter data for accurate billing purposes and generate exceptions and MIS reports for proper planning, monitoring, decisions and taking corrective actions on the business activities by the management.

It provides continuous online monitoring and logging of the following parameters in respect of all incoming and outgoing feeders, Distribution Transformers and consumers on real time basis : -

It is a database with analytical tools that enable interaction with other information systems.

- Consumer Information System (CIS), billing systems, and the NEA web site
- Demand Side Management System (DSMS)
- Enterprise Resource Planning (ERP) power quality management and load forecasting systems



- Mobile Workforce Management (MWM)
- Geographic Information System (GIS)
- Distribution Transformer Management System (DTMS)

One of the primary functions of MDMS system is to perform validation, editing and estimation (VEE) on the AMI data to ensure that despite disruptions in the communications network or at customer premises, the data flowing to the systems described above is complete and accurate. The system verifies and validates the meter related data of Consumer. If data is not validated, it alert the supervisor and shows possible correct and estimated correct data.

The MDMS system prepares final billing data and send to Billing System for Payment Collection. The MDMS system will give complete electrical hierarchy with energy audit report of the distribution system of whole NEA or any particular Branch/Distribution Center to monitor total energy flow and consumed by consumers which helps to detect areas/locations where high energy losses are happening.

AMI data will support the following areas:

- System operating information
- Asset “health” information
- Operations to optimize asset utilization
- T&D planning
- Condition-based maintenance
- Engineering design and construction
- Consumer service
- Work and resource management
- Modeling and simulation

At the consumer level, smart meters communicate consumption data to both the user and the NEA. Smart meters can provide more information to make consumers more aware of their energy usage. Going further, electricity pricing information supplied by the NEA enables load control devices like smart thermostats to modulate electricity demand, based on pre-established consumer price preferences. More advanced customers deploy distributed Energy Resources (DER) based on these economic signals. The consumer portals process the AMI data in ways that enable more intelligent energy consumption decisions, even providing interactive services like prepayment.

Online Payment of NEA Electricity Bill

Sajun Shrestha
Chief, Computerized Billing and Networking Division, NEA

Nepal Electricity Authority (NEA) is a government organization of Nepal. Broadly it deals with Generation, Transmission and Distribution of electricity. NEA has always been striving towards enhancing the revenue collection of NEA since its establishment in 2042 B.S. It started its revenue collection through manual billing System for a long time. As the introduction of computers, NEA also started to use computers to digitize the data of revenue collection. PSICOBS was introduced as the first billing system in 2059 B.S. which used DBASE system to store data. Due to the digitized data, there was an ease in billing and reporting of electricity bills of NEA consumers. In the last decade computer system developed significantly. NEA also upgraded its billing system to client server mechanism with windows and Linux operating system for its better performance, reliability, redundancy, high availability and security.

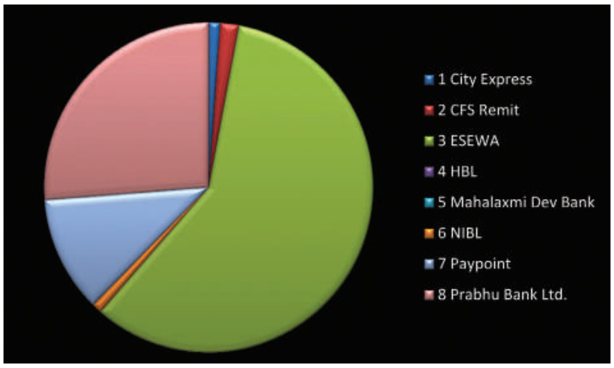
NEA billing system is not fully automated but it is proceeding for automation in its billing and payment system. Conventional billing system transformed to digitize system with time; it drastically reduced the need of human resource involvement and the concerned budget on paperwork. It also made reporting system and tracking mechanism easier for customer records. Customers also benefited by computerized bills, receipts and prompt response from the Billing mechanism.

In the process of data digitization, about 96% of consumer data has been successfully digitized whereas about 4% are in process, hopefully we will achieve it soon. We have digitized 146 collection centers among 168 and rest 22 Collection centers are in remote area.

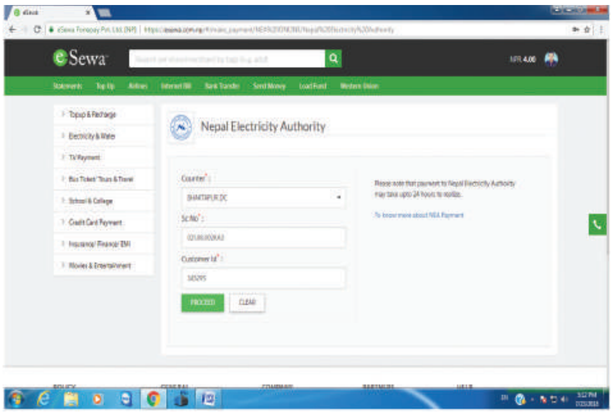
Focusing on the service of our valuable consumers we have implemented Any Branch Payment System (ABPS) in Kathmandu valley for 16 collection centers so that consumers can pay their bills from any branch according to their convenience.

Technology is changing, human needs are speeding up and automation has become the most essential part of human life. So we started online electricity bill payment system since Bhadra 2074 in NEA bill pay through Venders. NEA has made an agreement with 8 vendors (CFS Finance, City express, E-sewa, HBL Mahalaxmi Dev Bank, NIBL Pay Point and Prabhu bank Ltd.) for online collection which are appreciably collecting the electricity bills daily. Customers can pay their bills using e-banking, mobiles apps, KIOSK machine and their Community based collection offices. As per NEA Board's Decision one consumer can pay only up to the bill amount of NRS 1, 00,000 per month as a system constraint.

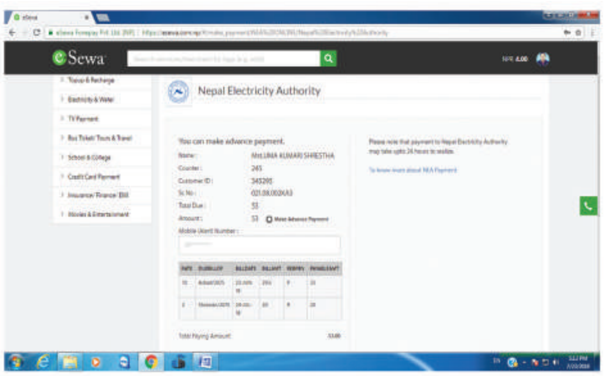
Customers can see their payment details through our website www.nea.org.np/chkbill filling the spaces by their related branch name, SCNO (Consumer number) and Customer ID.



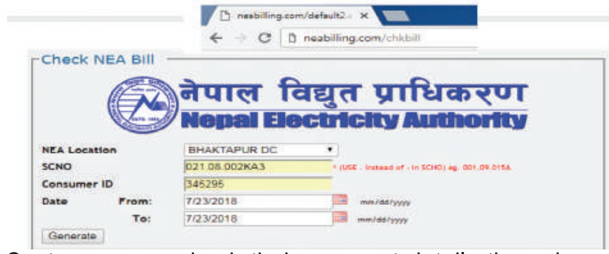
This is the real data of Merchant wise Online Collection scenario on pi-chart. Vendors name according to higher collection percentage are E-sewa, Prabhu Bank, Paypoint, CFS Remit, NIBL, City Express ,Mahalaxmi Development Bank and HBL respectively.



Customers need to create an account in E-sewa and login. Then go to electricity and water and select counter name (Branch Name), type scno (Consumer number) and customer ID and click on proceed.



Total payable amount with rebate/penalty is shown. Consumer can pay the bill clicking “Confirm” button or can pay in advance clicking on “Make advance payment”. Payment will be done if balance exists in e-sewa account. Otherwise customer can deposit cash amount in e-sewa or transfer from their related banks e-banking service. Then e-sewa provides concerned receipt for payment in .pdf format.



Customers can check their payment details through our website www.nea.org.np/chkbill . They can choose the concerned branch office name , put customer number and ID with required date and click on generate.

Customers can see the details of their monthly payment status with date.

Online Payment through Global Bank mobile App

Customers using NTC Mobile App also can pay electricity bill through NEA payment. Customers need to choose branch name, put customer number and ID and click submit.

Customers using Global Bank Mobile App also can pay electricity bill through payment. Customers need to choose branch name, put customer number and ID and click submit.

Cross-Border Electricity Trade Opportunities and Challenges for Nepal

Prakash Gaudel
Deputy Manager, Environment and Social Studies Department, NEA

Abstract

Nepal, with abundant hydropower potential and situated in a geopolitically important place, has the opportunity for cross-border electricity trade. The paper argues that for Nepal, the trade of electricity with neighboring countries of India and China is of both strategic and financial importance. This is because, even if Nepal develops all the potential hydroelectricity and export to neighbors, the contribution of such export will also be insignificant to them where the installed capacity have already crossed hundreds of thousands megawatts. In such backdrops, the paper attempts to explore the major opportunities and challenges of cross-border trade of electricity for Nepal. The paper delves into Nepal's existing plans , policies and regarding which, the paper urges for serious consideration in formulating or implementing them. Presenting the current status of bilateral and multilateral agreements and institutional arrangements, the paper reinforces the fact that cross-border electricity trade is not an easy task. Nevertheless, with prioritization of fulfilling internal demands, it is high time for Nepal to address the existing challenges and grab the opportunities offered by cross-border electricity trade. For this, the paper entails for the development of national strategy in lieu of considering electricity as trade commodity only.

Key Words: hydropower, cross-border, transmission lines, electricity trade, regional cooperation.

1. Background

Nepal, one of the South Asian nations, is surrounded by two most populous nations, China in the North and India in the remaining directions. With expanding economies, there is a growing demand for electricity in South Asia as well as in China. To meet this energy demand, the electricity is currently being produced from different sources in the region. This is mainly guided by naturally available resources. For instance, India and China are rich in fossil fuels, mainly coal; whereas Nepal is not rich is fossil fuel but has abundant water resources. Therefore, the electricity production in India and China are dominated by thermal power plants (Table 1) which depend on supply of fossil fuels and that of Nepal is hydro-dominated. The table below depicts the current electricity generation by source types in Nepal and Nepal's immediate neighboring nations.

With rising population and speeding economies, there is a need of more reliable and sustained supply of electricity. Nepal, as locked between the two giant nations, has the opportunities for cross-border electricity trade and the potentiality to change Nepal from land locked to electricity linked nation. This paper first discusses the existing cross-border trade of electricity and then analyze the

Table 1: Current Electricity Generation

S.No.	Energy Type	Source Type	Installed Capacity (MW)		
			Nepal[1] (June 30, 2018)	India[2] (May 31, 2018)	China[3] (2017)
1	Hydropower		1,006.78	49,889.23	341,190
2	Thermal	Diesel	53.41	837.63	1,106,040
		Coal		196,957.50	
		Gas		24,897.46	
3	Nuclear		-	6,780.00	35,820
4	Renewals	Solar	0.68	21,651.48	130,250
		Wind	-	34,046.00	163,670
		Geothermal	-	-	
5	Others	Biomass/Cogeneration		8,700.80	
		Waste to energy		138.30	
Total			1060.87	343,898.40	1,777,030

1 For detail, http://www.doed.gov.np/operating_projects_hydro.php
2 Ministry of Power, Government of India
3 https://chinaenergyportal.org/en/2017-electricity-other-energy-statistics-update-of-june-2018/

applicable national plans and policies. The cross-border agreements and institutional mechanisms for such trade are then discussed. With such backdrop, the paper then presents the opportunities and challenges of cross-border electricity trade for Nepal.

2. Nepal's Cross-Border Electricity Trade

Globally the cross-border electricity trade is gaining momentum. The governments and international organization are prioritizing such trade because of lowering costs, diversification of supply and tapping into low carbon or renewable energy sources (UN-ESCAP,2018). However, trade of electricity requires strong cross-border interconnections of transmission lines and mutual cooperation among the nations.

At present, Nepal has interconnecting transmission lines with India only and there is no any trade of electricity with China. The cross-border electricity trade between Nepal and India is predominantly characterized by the import of electricity needs of isolated areas of both sides of border. All together over 20 cross-border bilateral power exchange facilities are operational at 11kV, 33kV and 132kV. The total electricity flow from cross-border transmission lines of capacity 33kV to 400kV is about 488MW (MoEWRI, 2018). Though Dhalekbar–Muzaffarpurcross-border transmission line is of 400kV capacity, it was being charged at 132kV since its operation in 2016 and recently upgraded to 220kV in July, 2018. These existing lines are currently being used mainly for importing electricity from India. Further, 11kV cross-border lines connects Jaljibe with Dharchula, Baitadi with Pithoragarh and Pipli with Dharchula.With existing cross-border transmission lines, trade of electricity with India has been mainly dominated by imports which is in increasing trend. The imports have increased by more than threefolds in a period of just 8 years. There is nominal volume of electricity being exported to India and the trend is decreasing (Table 2).

Table 2: Cross-border Electricity Trade with India

S.No.	Fiscal Year	Import (GWh)	Export (GWh)
1	2016/17	2175.04	2.69
2	2015/16	1777.68	3.15
3	2014/15	1369.89	3.17
4	2013/14	1070.47	3.40
5	2012/13	790.14	3.60
6	2011/12	746.07	4.12
7	2010/11	694.05	31.10
8	2009/10	638.68	75.07

Source: NEA (Annual Reports)

The maximum energy imported as per the Kosi and Mahakali Agreements total about 30MW (10MW from Kosi and a maximum of 20MW from Tanakpur for 70 million units). Ironically, the dry season imports is only about 17.5MW for these river treaties (MoEn, 2009). The remaining major share of import is from the power exchange agreements and commercial arrangements with power trading companies. Before entering into these agreements, it is worthwhile to first look into Nepal's plans and policies that dictate the cross-border electricity trade.

3. Nepal's Plan and Policy Regime

The concept of regional trade of electricity is not new for Nepal, at least in plan and policy documents. Initially, the trade of electricity between Nepal and India were guided by the bilateral agreements of Kosi and Gandak done in the 1950s. Nepal has also reflected the potentiality and possibility of cross-border hydroelectricity trade through its own plans and policies. The Hydropower Development Policy of 1992 has first envisaged to export hydroelectricity produced in excess to the national demand. The following subsection deals with the existing national policies and plans of hydropower and transmission line development in relation to cross-border electricity trade.

3.1 Hydropower Development Policy, 2001

In Nepal, hydroelectricity trade across the border is mainly guided by the Hydropower Development Policy of 2001. The policy envisages hydropower, from its objectives, to be developed as an exportable commodity. The policy has encouraged the export of electricity by considering the abundant hydropower generation capacity in the country. For such trade, the Policy has prescribed a strategy of bilateral or regional cooperation in the hydropower development sector. The Policy believes that the development of hydropower in Nepal will not only support the domestic economy but also the regional economy. Since the policy is focused on development, there is no mention of hydropower import.

3.2 Water Resources Strategy, 2002

The Water Resources Strategy (WRS) of 2002 is the first document of Nepal to acknowledge the principles of Integrated Water Resources management (IWRM). One of the specific objectives adopted by the WRS is 'to generate hydropower to satisfy national energy requirements and to allow for export of surplus energy'. As a long term purpose, in 25 years of time (by 2027), the WRS envisages the development of 22,000MW of hydroelectricity. As such large hydropower generation will meet the domestic energy demand, the Strategy aims at increasing revenues by exporting surplus energy of as much as 15,000MW to India and other neighboring countries.

3.3 Ten-year Hydroelectricity Development Plan, 2009

A taskforce for formulating the '10 year Hydroelectricity Development Plan' was formed by the Government of Nepal (GoN) on December 3, 2008. The taskforce came up with the final report in August, 2009 prescribing the generation of 10,000MW in ten years. This 10-year plan envisages the development of storage and non-storage projects in the ratio of 60:40, so that Nepal can export 3,000 to 5,000MW of electricity.

3.4 Twenty-year Hydroelectricity Development Plan, 2010

Without considering the essence and the findings of the final report of the task force for formulating 10 years plan of hydropower development, the GoN formulated another taskforce for formulation the '20 year Hydroelectricity Development Plan' on August 26, 2009. The task force was primarily given the responsibility of preparing a plan of generation 25,000MW in two decades. The task force submitted the report in April, 2010 which envisages the generation of total of 37,628MW of electricity including multipurpose projects of Pancheshwar, Karnali Chisapani and Sapta Koshi by 2029. If these three multipurpose projects are not conceived, the total generation is projected to be 20,354MW for the same period of 20 years. Since the generated electricity cannot be fully consumed in Nepal, the task force recommends for export to India. The plan has also considered the potentiality of cross-border transmission lines as well as the SAARC regional power grid and has recommended for at least one cross-border line from each major basin of Nepal.

3.5 National Energy Crisis Mitigation and Electricity Development Decade, 2016

A concept paper on mitigation of national energy crisis and electricity development decade was presented by the then Ministry of Energy in January, 2016. The plan is to import up to 930MW of electricity from India up to 2 years in order to fulfill the domestic demand of Nepal. In ten years of time (by 2026), generation of 10,000MW of electricity including 5,000MW from storage projects is anticipated. After fulfilling the internal demand, the plan suggest for the export of excess hydro-electricity. For this, the plan has foreseen the study and execution of cross-border transmission lines of 400kV capacity which includes a number of projects like New Butwal-Gorakhpur, Duhabi-Purniya, Kohalpur-Lucknow, Lamki-Bareli, Attaria-Bareli and Chilime Hub-Kerung.

Analyzing these national level plans of hydropower development, one can clearly visualize that there is no consideration of the previous plans and their implementation. The focus has always been kept on formulating fancy plans, one after another, emphasizing only onsetting targets of thousands of megawatt of

Table 3: Fluctuating Targets of Hydropower Generation in Nepal

S.No.	Policy/Plan/Strategy	Target		Remarks
		Period	Capacity (MW)	
1.	Water Resources Strategy, 2002	2002-2027	22,000	including 15,000MW for export
2.	10 year Hydroelectricity Development Plan, 2009	2009-2020	10,000	including export of 3,000MW to 5,000MW
3.	20 year Hydroelectricity Development Plan, 2010	2010-2029	37,628	including 3 multipurpose project (Karnali ChisapaniPancheshwar&Saptakoshi)
4.	Electricity Development Decade, 2016	2016- 2026	10,000	later upgraded to 17,000MW in 7 years

Source: WECS, 2002; MoEn, 2009 and 2010

hydropower production (Table 3). However, in the lack of ownership and enforcement of serious plans by the authorities, the hydropower sector of Nepal is underdeveloped.

3.6 Transmission System Development Plan of Nepal, 2018

The Rastriya Prasaran Grid Company Limited (RPGCL), owned by GoN, has prepared Transmission System Development Plan in 2018. The plan has proposed the construction of 3,192km of 400kV capacity and 1,160km of 220kV capacity transmission lines. The plan also includes the six Nepal-India cross-border connection points in the Terai Region and two Nepal-China cross-border connection points in the Himalayan Region. These cross-border lines which will be capable of transmitting a total of 15,900MW of electricity (Table 4) are much same as proposed by the Electricity Development Decade, 2016.

Table 4: Proposed 400kV Cross-border Transmission Lines

S.N.	Cross-border TL Project	Length, km (up to border)	MW Flow
A. Nepal -India			
1	Dodhara-Bareli	58	3,000
2	Attariya-Bareli	30	700
3	Phulbari-Lucknow	44	2,600
4	Butwal-Gorakhpur	30	2,500
5	Inaruwa –Purnera	50	1,800
6.	Dhalkebar-Muzaffarpur	39	3,100
	Sub-total	251	13,700
B. Nepal-China			
1	Chilime-Kerung	14	1500
2	Upper Arun –Latse	23	700
	Sub-total	37	2,200
	Total (A+B)	**288**	**15,900**

Source: MoEWRI and RPGCL, 2018

The Transmission Plan was prepared as per the GoN latest targets of developing 15,000MW in 10 years and around 40,000MW by the year 2040. Prior to this, in 2015, Nepal Electricity Authority (NEA) has prepared a 'Transmission Master Plan of Nepal' from the year 2015 to 2035. Similarly, Joint Technical Team (JTT) of Nepal and India has formulated an 'Integrated Master Plan for Evacuation of Power from Nepal to India' up to the year 2035.However, the Plan of 2018 assumes that these prior plans were mainly targeted for electricity exports to India, and thus calls for updated master plan focusing more on internal consumption.

4. Cross-Border Agreements

The cross-border agreements on electricity trade can mainly be categorized into two types. The first includes the river project agreements which were primarily done for developing irrigation and flood control, and electricity has come out as a byproduct. The second one include power exchange/trade agreements which were done with the primary objective of exchange (or trade) of electricity. For Nepal, both types of agreements are predominantly bilateral and done with India only.

4.1 Bilateral Agreements

4.1.1River Project Agreements

There are some rivers, originating from China and flowing towards to Nepal. However, till date no agreement has been signed between Nepal and China for development of these rivers. On the other hand, Nepal has signed some bilateral agreement with India regarding the development of projects on transboundary rivers which flow from Nepal to India. Kosi Agreement, 1954 (amended 1966); Gandak Agreement, 1959 (amended 1964); and Mahakali Treaty, 1996 are the existing major bilateral agreements between Nepal and India. These agreements do have some provisions for cross-border electricity exchange/trade.

As per Article 4 (ii) of the amended Kosi Agreement, Nepal is entitled to use up to 50% of the total hydroelectric power generated by any powerhouse situated within 10mile radius from the Koshi barrage on payment of certain tariff fixed by mutual understanding. This 50% electricity was materialized only in October 31, 1971 when the first two units of four turbines of Kataiya powerhouse, built in India on the irrigation canal drop, started generation (Pun, 2009) almost a decade after the completion of Koshi barrage in 1962. Though this supply of electricity is of no significance in comparison to the benefits to India in terms of irrigation and flood control, Upadhyay (2012) claims that the supply of electricity to Nepal is not a matter of agreement and negotiation but a matter of right- an entitlement. The Kataiya powerhouse was damaged by the Koshi flood of 2008 and as a result Nepal has been deprived of getting the said share of electricity on the agreed tariff.

Similarly, under the Gandak Agreement, a 15MW powerhouse was to be constructed by India in Nepalese territory using the canal drop Main Western Canal and a transmission line from the powerhouse in Nepal to Indian border. Though the powerhouse was commissioned in April 1979, the Gandak Agreement's 60% load factor for the powerhouse to be handed over to Nepal [Article 8 (iii)], forced Nepal to buy Gandak electricity from 1979 to 1981 (Pun, 2007).

Under the Mahakali Treaty (Article 2), Nepal obtained a supply of 70 million kWh (units), as against the earlier agreed figure of 20 million kWh, of electricity on a continuous basis annually, free of cost from Tanakpur Hydropower Plant located in India. The increase in energy from 20 million kWh to 70 million kWh is based on the calculation of the increment of power due to pondage on 2.9ha of land at elevation of 250m. Though not mentioned explicitly in the Treaty, the number that has been agreed was half of what increment the pondage contributes to the production of energy (Upadhyay, 2009).

4.1.2 Power Exchange Mechanisms

Though Kosi and Gandak agreements were done in 1950s, the first power exchange between Nepal and India materialized only in 1971 through the Kosi Power under the Kosi Agreement which was initially supplied to Biratnagar, Dharan and Rajbiraj (Pun, 2009). In due course of time, cross-border electricity exchange increased. By 1983, Nepal imported about 6MW of electricity from India for supply to border towns from 11 power exchange points and exported about 5MW from only Birgunj-Raxual point (Pun, 2009).

The tariff of such exchanged electricity across border is decided by Power Exchange Committee (PEC)[4]. Further, NEA concluded Power Sale Agreement on December 12, 2011 with Power Trade Corporation of India for importing 150MW power, mainly from Dhalkebar-Muzaffarpur 400kV cross-border transmission line. This Agreement is yet to be operationalized. Apart from this, NEA has been purchasing electricity through NTPC VidyutVyapar Nigam Limited of India.

4.1.3 Power Trade Agreements

As early in 1996, a Power Trade Agreement between Nepal and India was signed at secretary level. However, the agreement never came into implementation due tothe issue of parliamentary ratification (Pun, 2009).Almost after about two decades, Nepal and India signed another agreement "Indo-Nepal Electric Power Trade, Cross Border Transmission and Grid Connectivity Agreement" in October 21, 2014. This agreement is perceived to open new doors from cross-border electricity trade.

4.2 Multilateral Agreements

Even though the cross-border electricity trade of Nepal is dominated by bilateral arrangements as in the case of other South Asian nations, there are rooms for graduating from current bilateral arrangements to multilateral arrangements. For Nepal, the bilateral arrangements with China, the northern border is also strategically important.

There were efforts, in the past, for realizing the regional power grid project involving Bangladesh, Bhutan, India and Nepal. However due to India's negation, the project could not march forward (Pun, 2009). But, recently in 2017, with the visit of Prime Minister of Bangladesh to India, both the countries have agreed on conceiving of trilateral understanding between Bangladesh, Bhutan and India for the cooperation in the field of hydroelectric power[5]. Though this is a good start, the detachment of Nepal from this cooperation is quite questionable.

Beyond trilateral cooperation, at broader scale, the SAARC Energy Ring concept was first announced in 2004.

4. The PEC was formed in April 18, 1991 and is responsible for finalizing and periodically updating the matters related to exchange of power, including the tariff for the exchange of power between Nepal and India.
5. India-Bangladesh Joint Statement during the State Visit of Prime Minister of Bangladesh to India (April 8, 2017), Government of India, Ministry of External Affairs. Retrieved from: http://www.mea.gov.in

Unfortunately, there has no substantial progress towards the regional interconnectedness and cooperation (UN-ESCAP, 2018).Realizing the need and benefits of cross-border electricity trade, SAARC Framework Agreement for Energy Cooperation (Electricity) was signed by the member countries of the 18th SAARC Summit held in Kathmandu in November 2014. However, things have not moved forward as expected.

5. Opportunities

There are notable examples around the globe which depict the benefits of cross-border electricity trade. Such trade is accompanied by establishment of regional grid and powerful institutional arrangements. The Southern African Power Pool (SAPP) interconnecting 12 countries, provide an example of good practice in the regional energy cooperation (Rahman et al, 2011). Similarly, the other successful examples from the developing world includes West African Power Pool (WAPP) and Central American Power Market (Oseni and Pollitt, 2014). Similar opportunities for regional energy cooperation do exist in the South Asian regions. The opportunities for cross-border electricity trade specific to Nepal are discussed below.

5.1 Seasonal Variation

Steep topography and perennial rivers makes Nepal ideal for hydropower generation. However, Nepal's hydropower is characterized by seasonal fluctuations; which are indeed the ramification of the too little and too much water. The four months of June to September is characterized by the Monsoon which brings as much as 80% of the total precipitation in the country. Even in the pre-monsoon season, the high summer temperatures melts the snow and glaciers resulting in the increased discharge in the river. During this summer (pre-monsoon and monsoon) season, the hydropower generation of Nepal is maximum however the demand is not high.

On the contrary, in the same season, the electricity production in India goes down. This is mainly due to the fact that the major share of electricity generation in India is from coal. In the wet season the processes of mining, processing and transportation of coal are affected resulting in required availability of amount and efficiency of coal. Moreover, in the summer season, the electricity demand surges in India. This is mainly attributed by the increased use of cooling appliances and increased groundwater pumping for irrigation. Therefore, there seems perfect match for cross-border electricity trade between Nepal and India as the energy peak demand in winter and summer of Nepal and India are in contrast and can be used as complementary for exchange. This is the reason why Nepal proposed for the concept of 'Energy Banking' with India.

5.2 Cleaner and Climate Friendly Hydropower

Nepal's hydropower (untapped potential and current generation), is regarded as much cleaner sources of energy. On the opposite, both neighboring nations are heavily dependent on fossil fuels for thermal generation, the major greenhouse gas (GHG) emitters. Nevertheless, we should not deny the fact that both the nations are transforming themselves from the non-renewal sources towards renewals, as their international commitments. Furthermore, with the addition of hydro-based electricity imports, the flexibility of the grid will increase to adjust the intermittent supply for other renewals like solar and wind. Even for thermal and nuclear which take longer time to start or shut down, the hydropower have comparative advantage of quicker adjustment to the changing load.

Moreover, cross-border electricity trade need to be looked from a new perspectives of fulfilling Sustainable Development Goals as well as global climate commitments. Clean hydropower production from Nepal can offset at least some fossil fuel consumption and help reduce global emission of greenhouse gases. This is one of the major opportunities for cross-border hydro-electricity trade where both neighboring nations heavily depends on fossil fuel.

5.3 Strategic Opportunity for Nepal

There is a greater scope for Nepal regarding cross-border electricity trade from strategic point of view. As depicted in Table 1, the neighboring countries have already crossed hundreds of thousands of megawatts of electricity generation and therefore the amount of electricity to be exported from Nepal is insignificant from the financial perspectives. However, the geopolitical context and the security concerns of both neighbors provide ample strategic opportunities for Nepal to export its hydropower in the near future.

It is the high time to integrate the individual national energy markets of China, Nepal and India including other countries of South Asia Region. As Nepal has already been interconnected with the Indian electricity market, the integration with northern market is anticipated to increase the reliability and security of the energy market. Opening of new cross-border transmission lines towards China is expected to end the monopoly of the Indian market, transforming the current bilateral trades of electricity to trilateral. The assurance from multiple buyers will also help Nepal to develop more hydropower through domestic or foreign investments.

6. Challenges

Despite having significant potential of techno-economically feasible hydropower, Nepal is not yet successful in meeting its own demand. On the contrary, policy regime for hydropower development in Nepal assumes that electricity may be exported to India and beyond. Top priority needs to be given to internal consumption and on increasing the per capita electricity consumption.

At the regional level, there had been talks on the energy cooperation in South Asia. The SAARC energy grid has also been included in the agendas of such talks for quite some time. However, no any generous progress has been made and the SAARC energy ring/grid still seems elusive (UN-ESCAP, 2018). Therefore, it is quite important to identify the challenges for such cooperation. For successful execution of cross-border electricity trade, there is the need to address the following challenges that prevails at the national and regional context.

6.1 Lack of Determined Plans and Institutions

From 2002 since the formulation of WRS to the Electricity Development Decade of 2016, different targets for hydropower generation were spelled out (Table 3). There is lack of coordination or acknowledgement among these plans.

In case of cross-border transmission lines, there are two major issues. The first issue is about the interlinkages and coordination of the recent plan of 2018 prepared by RPGCL with the previous plans of NEA and JTT. The question here is whether or not the 2018 transmission plan replaces previous plans. The second issue is about the ownership and implementation.

6.2 Regional Cooperation: Not an Easy Task

The cross-border trade with India may not be as easy as perceived or depicted by national plans and policies. The India's Guidelines on Cross-Border Trade of Electricity, 2016is reported to have some contradictory clauses with the essence of SAARC Framework Agreement, 2014 and Indo-Nepal Power Trade Agreement, 2014(Pun, 2018).

The World Bank's Ganges Strategic Basin Assessment Report (2014) has also highlighted that the potential for power trade among the basin countries is significant and simple to negotiate. However, as applied in the case of water resources, India is seemed to have its cross-border electricity cooperation to be fixed at bilateral levels with Nepal. Khadka and Adhikari (2005) has identified four major barriers to regional power market in the South Asian region, which includes policy barrier, technical barriers, institutional barriers and commercial or financial barriers, whereas, Malla (2005) has identified' post legacy of mistrust'among the south Asian countries as one of the major concerns for regional energy cooperation.

6.3 Electricity Trade: Does not necessarily lead to Prosperity

For the desired economic growth of any country, the (hydro)-electricity should be used as an input for internal consumption rather than just for exporting as a raw material. However, the national policy should not totally ignore the possibility of cross-border electricity trade where possible.

There are examples around the world which portray that selling hydropower, mainly by hydro-rich but economically weak nations, would not necessarily lead to prosperity. The Paraguay's hydropower export is one of the typical example where Paraguay alone is the main electricity exporter in South America but is still the second poorest nation in the region (Pun, 2008; Thanju and Canese, 2011). Similarly, Bhutan, a hydropower rich country like Nepal, exports major share of its hydroelectricity to India at nominal rates.[6] However in dry season, Bhutan needs to import the power back from India at higher rates (SARI/EI, 2016).

6.4 Storage Projects are not only Hydropower Projects

The cross-border hydroelectricity sale for Nepal is constantly and repeatedly being reflected in national plans and policies. These plans mainly rely on developing storage hydroelectric projects so that generated hydropower can be exported for financial returns. This concept is also equally strengthened by multilateral

6. Bhutan sells electricity as much cheaper price in the region. The electricity from the 336MW Chhukha HP is sold as the rate of Bhutanese Ngultrum (BTN) 2.25 per unit (revised from BTN 2 per unit from Jan. 2014); BTN 1.98 per unit (revised from BTN 1.75 per unit from Jan 2008) from 60MW Kurichhu HEP and BTN 1.98 per unit from 1020MW Tala HEP (SARI/EI, 2016).

agencies.The World Bank's Ganges Strategic Basin Assessment Report has emphasized that storage projects in Nepal would provide hydropower as the greatest benefits and there is little to do with flood control and water regulation in the downstream. Pun (2013) strongly portrayed this report as Indo-centric and suggested Nepal not to rush just because of significant power trade. But despite the multiple benefits of storage projects which surpass the benefits of electricity generation, the storage projects are being perceived as hydropower projects only. For example there is no consideration of downstream benefits from the proposed 1200MW Budhi Gandaki Storage Project. Decision makers of Nepal need to see Budhi Gandaki Project from multipurpose perspective which has potential to bring regional benefits (Upadhyay and Gaudel, 2014).

6.5 Increasing Socio-Environmental Concerns

The hydropower is considered as a much cleaner source of electricity. However hydro-projects are facing increasing concerns from the society and environment.Waterdiversion for hydropower generation can make downstream stretch completely dry which has adverse impact on the aquatic and terrestrial ecosystem as well as livelihood of the people. This is particularly applicable for run-of- river projects. For larger projects, construction of dams in the Himalayan Region includes complex as well as costly structures characterized by multiple problems. Besides different socio-economic impacts including involuntary displacement and loss of fertile land and many others, the creation of huge reservoirs on the lap of Himalayas will also affect the microclimate of the region. Therefore, clear scrutiny of projects not only from the economic or cross-border trade perspectives but also from the social and environmental perspective has to be done. However, the multiple national plans formulated one after another for the hydropower sale across the border seriously lack socio-environmental concerns.

7. Conclusion and Way Forward

The share of huge hydropower potential (about 83,000 MW) of Nepal, is merely less than five per cent of the current installed capacity of China and hardly one fourth of already installed capacity of India. So, the cross-border export of all feasible hydroelectricity from Nepal to these giants, will have hardly any nominal impact on their energy systems. By saying this, however, we cannot deny the fact that the energy trade of Nepal is of strategic importance. It is, therefore, necessary for the policy makers of Nepal to deal with this cross-border trade from strategic point of view and deal diplomatically with the neighboring nations.

For this, Nepal needs to formulate its own national and economic strategy related to cross-border electricity trade. Moreover, the environmental and social consequences of hydropower are on higher sides. Therefore,Nepal has to take care of optimum harnessing of rivers for hydropower production with prioritization of the domestic consumption. Realizing the need of trilateral and regional cooperation, Nepal should immediately attempt for executing cross-border transmission lines with China as well as take initiatives in implementing the SAARC Framework Agreement and the Power Trade Agreement with India.

References:

More than 20 references are used in this article .

दुर्घटनाका कारण कर्मचारीको मृत्यू भएको अवस्थामा वीमा दावीका लागि आवश्यक कागजात

- आवश्यक विवरण भरिएको वीमा दावी फाराम
- कार्यालयले तयार पारेको दुर्घटना प्रतिवेदन
- शव परिक्षण प्रतिवेदन
- दुर्घटनाको प्रहरी प्रतिवेदन
- मृत्यू दर्ता प्रमाणपत्र
- मृतकको नागरिकताको प्रतिलिपि
- हकवालासँगको नाता प्रमाणपत्र

Prospects of Bagasse-Based Cogeneration from Sugar Industries in Nepal

Er. Shammy Karna
Assistant Manager, Power Trade Department, NEA

Introduction

Cogeneration is the simultaneous generation of electrical power and thermal energy through a single fuel called bagasse. Bagasse cogeneration describes the use of fibrous sugarcane waste, bagasse, to cogenerate heat and electricity at high efficiency in sugar mills. Meeting electricity demand in sustainable manner is one of the major challenges that Nepal is facing. At present electricity generation in Nepal is mainly through hydropower. The time has come that the country must search now for alternative sources for electricity generation like renewable and non-conventional sources such as solar, wind or hybrid technologies. Country has launched a programme to enhance proportion of renewable energy in the electricity mix to address the present energy crisis situation.

A baseline survey of energy intensive industries undertaken in 2012 identified a potential of generating electricity of around 25 MW through cogeneration from sugar industries. Through additional measures in the sugar industries, the capacity could be increased to 93 MW which is equivalent to about one fifth of the current hydropower generation during the dry season. Out of the total potential, more than 50% of the capacity could be connected to the national grid. This would provide a sigh of relief during the dry season, when energy management becomes a challenging task from the system operation point of view. Further, the industries have been depending on fossil fuel as an alternative source for electricity. Hence, cogeneration would support not only in operating the industries smoothly but also in reducing adverse environmental impact caused by burning of fossil fuel and decrease dependency on import of fossil fuel.

Harnessing electricity through cogeneration stands as a promising new source in the electricity mix of Nepal. Bagasse is the by-product of the cane crushing in the sugar mills.The bagasse percentage varies from 23% to 37% of the total weight of sugarcane. It is a fibrous material and contains moisture in large amount, approximately 48-50 %. Its moisture content can be reduced by better de-watering, improved processing or by simply leaving the bagasse to dry. The calorific value of bagasse depends upon the moisture content and the amount of sucrose present in the bagasse.

Bagasse Cogeneration System

Advanced cogeneration systems are employed for simultaneous generation of process steam and electricity. They run by employing high pressure boilers and condensing cum extraction turbines. It has become standard to produce both steam and electricity necessary for driving the sugar processes. This sequential generation of electrical power and thermal energy (steam) is referred to the production of combined heat and power or cogeneration.

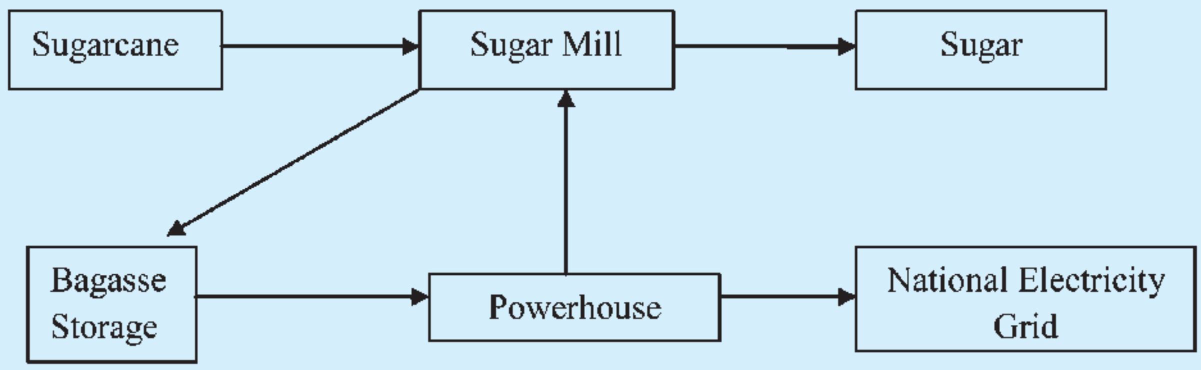


Figure: Schematic diagram of power cogeneration in sugar mills

Potential of Bagasse Cogeneration

Sugar industries in Nepal are mainly situated in the terai region. The favourable climatic, edaphic and topographic conditions make the southern parts of Nepal a suitable region for sugarcane farming. There are various sugar industries with electricity generation capacity as listed as below:

S.N.	Name of Industry	Cogeneration Capacity
1	Reliance Sugar Industry	15 MW
2	Indushankar Sugar Industry Ltd.	3 MW
3	Annapurna Sugar & General Industries	3.5 MW
4	Everest Sugar and Chemical Industry Ltd.	3 MW
5	Mahalakxmi Sugar Mill Ltd	3 MW
6	Vashulinga Sugar Mill Ltd	15 MW
7	Sri Ram Sugar Ltd	3 MW
8	Bagmati Khandsari Sugar Ltd	3 MW

Policy and Regulatory Support

Government of Nepal has taken major decisions regarding the promotion of bagasse cogeneration. The policy and regulatory decisions/frameworks regarding bagasse cogeneration are follows:

- On Jestha 20, 2072,Government of Nepal (GoN) has made cabinet-level decision for promoting the cogeneration.
- In Magh, 2072,Ministry of Energy, GoN has issued Energy Crisis Mitigation Action Plan, 2072. In program number 27 of the Action Plan, following is stated,
  - A contract will be signed between GoN and sugar industries for connecting its surplus electricity to national grid after self consumption.
  - Power Purchase Agreement (PPA) will be signed with sugar industries.
  - Transmission Line from switchyard of sugar industry to NEA's substation will be built on sugar industries expenses.
- On Baisakh 25, 2075, Ministry of Energy, Water Resources and Irrigation has issued a White Paper which has focused on PPA of energy from Sugar Industries.
- Nepal Electricity Authority through its Board decision has approved the template of PPA regarding bagasse cogeneration. The major provisions incorporated in PPA for Bagasse generation are as follows:
  - Energy billing based on metered energy.
  - Posted Tariff Rate as applicable for RoR hydropower projects (Wet month NRs 4.80/kwh and Dry month NRs 8.40/kwh with 3% simple escalation for eight years) to apply.
  - Dry months considered from Mangsir 16 to Jestha 15 and wet months from Jestha 16 to Mangsir 15.
  - No penalty provision foreither parties.
  - 5% of the bill amount on account of delivered energy will be deducted and provided to the GoN for distribution to the sugarcane farmers as per the cabinet decision of GoN.
  - 50% work progress provision on date of RCOD (Required Commercial Operation Date) applicable to hydropower developers for Performance Guarantee forfeit/release waived.
  - Performance guarantee at the rate of Nrs. 600/kw

to be submitted before signing of PPA

- Performance guarantee to be released only if COD takes place by RCOD.
- COD (Commercial Operation Date) declaration after 7 days of satisfactory trial operation period.
- Financial closure to be achieved within one year period.
- PPA period of 25 years or contract period between GON and Sugar Industries or generation license validity period whichever is earlier.
- Sample contract energy table is given below:

Month		No. of days	Av. Power KW	Total Energy kWh	Outage & Losses kWh		Contract Energy kWh
Baisakh		31					
Jestha		31					
Asadh		32					
Shrawan		31					
Bhadra		31					
Ashwin		31					
Kartik		30					
Mangsir		29					
	16th onward	14					
Poush		30					
Magh		29					
Falgun		30					
Chaitra		30					
	1st 15th	15					
	16th 30th	15					
		365		0		0	0

Total Contract Energy (kWh) = 0 Plant Factor = 0.00%

Entities involved in Bagasse Cogeneration

The entities associated with bagasse cogeneration in Nepal are as follows:

- Ministry of Energy, Water Resources and Irrigation
- Ministry of Agriculture, Land Management and Cooperatives
- Department of Electricity Development
- Nepal Electricity Authority
- Concerned sugar industries

Barriers in Cogeneration

The major bottlenecks in harnessing cogeneration potential in Nepal are as follows:

- Lack of sugar industry's management Focus
- Sugar industries management does not take cogeneration seriously due to lack of awareness and being busy in solving other problems of sugar mill. In addition, the management does not have the competence to run a power plant.
- Financial Constraints
- Sugar mills do not have adequate resources to establish cogeneration facility.
- Small Mills
- Minimum 2500 tonnes crushing capacity is required for the mill to be economically viable for establishing cogeneration facility.
- Grid Connectivity
- Lack of grid connectivity is also a barrier in bagasse cogeneration.
- Unavailability of bagasse in off-season
- Unavailability of bagasse in off season is a constraint. Energy generation is limited to 4-5 months in a year.
- Lack of adequate policy and effective regulatory framework.
- Lack of technical capacity and low technological confidence.
- Lack of experience in commercial operation.
- De-motivation for Sugarcane Farming
- Delayed payment for sugarcane has de-motivated the farmers for sugarcane cultivation.

Conclusion

The overall review of the status of bagasse cogeneration in Nepal has demonstrated that Nepal has untapped potential of bagasse cogeneration which is expected to increase in near future. However, sugar sector in Nepal is very complex. Government of Nepal has taken several initiatives to enhance bagasse cogeneration which has received positive responses from the sugar sector. The barriers in this area as identified need to be addressed to promote the cogeneration growth in the country.

Besides the role of mitigating energy crisis through power generation from bagasse, it has also significant contribution to the improvement of voltage profile in the power system of Nepal by supplying reactive power. As NEA has already decided to sign power purchase agreements with the owners of sugar factories which are willing to cogenerate electric power, it is expected that we will soon have bagasse-based PPAs with various sugar factories in Nepal.

Economic Sustainability of Large Dams: Case study of Itaipu dam

Bhalabhadra Adhikari
Assistant Manager, Ghorahi- Madichour 132 kv Transmission Line, NEA

Background

It is well experienced and almost accepted by all Nations that small and medium sized hydro dams are economically sustainable. But what humor is going on for large Dams?

Though study and construction for some medium and large dams are in pipeline, Nepal has still only small dams for ROR/ PROR type hydro projects except Kulekhani dam. We often see unclear debates about construction of large dams in different Nepalese Medias.To some extent, these news and debates are justifying speculations for vested interests of different stakeholder in this regard. Is it exaggeration to say that conclusions can be made that plans for large dams are mostly influenced by other interests rather than founded on national interest ? Otherwise, we could have seen multidimensional debates rather than present level discussions.

It is obvious that large dam construction has multi-dimension with some dimension beyond conventional level thinking. Some are unseen and intrinsic to local level and even unpredictable during study. How can it be decided without fair discussion at least to those dimensions to known level? It is beyond the scope of anybody single to have idea of all dimensions of large dams so through this article I want to urge all to make this topic most debatable among different perspectives so that fair level of understanding could come to surface.

As other dimensions are beyond the scope of this Article, it is focused to bring in front of you, the studies for one crucial dimension: *"Economic sustainability of large dams".*

What studies Says For Economic Sustainability Of Large Dams?

The paper "Dams and Hydropower for Sustainable Development, by Yuksel" published in journal "Energy Sources, Part B: Economics, Planning and Policy, volume-4, 2009" mentions that the global debate about large dams is at once overwhelmingly complex and fundamentally simple. It is complex because the issues are not confined to the design, construction, and operation of dams themselves but embrace the range of social, environmental, and political choices on which the human aspiration to development and improved well-being depend.

An article on September 23, 2010 from "Russel Norman Environment & Resource Management56" states that there are many more large dams being removed in the US at this time than are being proposed and constructed. US probably built all the major dams that were ever going to be built before the 1980s, and today there is substantial momentum toward removing even some of the larger power and irrigation dams that were constructed in the early to mid-20th century. Notably there is a growing support for removing major dams on the Snake River in Oregon and Idaho.

The Oxford University report namely "Hydroelectric dams are doing more harm than good to emerging economies"by Bent Flyvbjerg and Atif Ansar after investigating 245 large dams worldwide concludes that for large dams, cost overruns, debt, inflation and harmful consequences make large dams very risky projects. As per report, with an average cost overrun of over 90%, large dams have one of the highest cost overruns among all infrastructure asset classes. This result is before accounting for negative impacts on human society and environment, and without including the effects of inflation and debt servicing. So, large dams in developing countries are not economically viable. Instead of obtaining hoped-for riches, developing countries risk drowning their fragile economies in debt owing to the ill-advised construction of large dams. The report revealed that the costs of large dams and similar failed mega projects have caused an explosive growth of debt in developing countries. For example, the actual cost of Tarbela dam, most of which was borrowed from external sources, amounted to 23% of the increase in Pakistan's external public debt stock between 1968-1984. Similarly, for the Chivor hydroelectric project in Colombia, the planners predicted that there would be no changes in the exchange rate between the Colombian peso and the US dollar during the construction period (1970-77). In fact, the Colombian currency depreciated nearly 90% against the dollar. Since over half the project's costs covered imported inputs, this depreciation caused a 32% cost overrun.

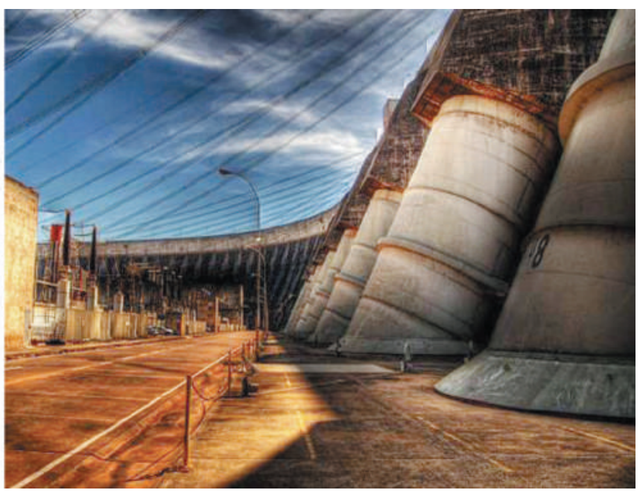
Case Study Of Itaipu Dam

The Itaipu hydroelectric power plant with an installed capacity of 14,000MW ranks as the world's second largest hydropower plant. Itaipu Dam is a bi-national hydroelectric dam (not multipurpose like irrigation or flood control) located on the border of Paraguay and Brazil. The resource used to run this dam is the Parana River, which forms a natural barrier between the two countries. The American Society of Civil Engineers considered the Itaipu Dam to be such an amazing achievement that they listed it as one of the Seven Wonders of the Modern World. The Itaipu hydro-electric facility supplies about 17.3% of Brazil's energy consumption and 72.5% of the energy consumed in Paraguay. But with less demand, Paraguay uses only 9 % of total generation from Itaipu dam (to meet 72.5 % of its demand) and for rest it gets royalty from Brazil. As per treaty, Paraguay will be receiving $124m a year until 2023.It consists of 20 generating units with a capacity of 700MW each. It produced 98.2TWh in 2012 (greater energy than by three Gorges), which made it the biggest generating hydropower plant in the world.

Some facts about Itaipu dam are;

- The deal between Paraguay and Brazil to build the dam was signed on July 22, 1966. Though construction did not begin until 1971, it was completed by 1980.
- Itaipu Dam is a series of 4 dams that are 738 feet high and 4.8 miles (7.87 km) long.
- It took 40,000 workers to build the dam. The majority of these workers were from Brazil. 149 of them were killed during construction. It took seven years to build.
- More than 10,000 families had to be relocated during construction to make way for the channel to divert the water. It took 12.3 million cubic meters of concrete to build the dam.
- Construction cost of Itaipu dam was US$ 19.6 billion at that time.

Being built for hydropower only, by inundating most fertile land of Paraguay, Itaipu dam suffered a 240% cost



overrun that impaired the nation's public finances for three decades. Despite producing much-needed electricity, it is likely Itaipu will never pay back the costs incurred to build it.

Conclusion

Evidences shows that only multipurpose large dams like three Gorges (built for flood control with main purpose including 22500 MW hydropower and navigation) can be economically sustainable. About 90% of worlds large dams built only for hydropower (not multipurpose) are economically not sustainable. Their construction proved to be worse than having no dam.

So economic studies of existing large dams suggests that smaller, more flexible hydroelectric projects that can be built quicker, and are more easily adapted to social and environmental concerns, are preferable to high-risk mega dams.

Norway is an excellent model of how a flexible approach can yield substantial payoffs. With 99% of its electricity produced from water, hydropower is highly successful in the country. Norway has mostly small and medium sized dams.

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Energy Mix : Antithesis of Putting all Eggs in One Basket

Subarna Sapkota
Assistant Manager, Power Trade Department, NEA

1. Background

Using different energy sources, suppliers and transportation means and routes to reduce dependency on a single resource or provider is energy diversification. A country that diversifies its energy mix insulates itself from energy disruptions and strengthens its energy security.

Current forms of supply may be insufficient, or inappropriate from the energy security or environmental perspective. Their prospects depend on the available resources, costs compared with competing alternatives, environmental impacts, cost of investment and infrastructure requirements. Unconventional source of energy like solar, bagasse and wind power have developed rapidly in recent years, and are seen as promising avenues in the context of Nepal.

In order to understand the economics of energy, diversification of both supply and consumption must be explored.

The term "energy mix" refers to the combination of various primary energy sources used to meet energy needs in a given geographic region. In the Nepalese perspective various sources of renewable energy like wood, biofuel, hydro, wind, solar, geothermal, waste and biogas can contribute in the energy mix.

The composition of the energy mix depends on:

- The availability of usable resources domestically or the possibility of importing them.
- The extent and type of energy needs to be met.
- Policy determined by historical, economic, social, demographic, environmental and geopolitical factors.

2. Significance of Energy Mix

The national energy mix is important as a strategic plan to fulfill the objectives of energy policies. The electricity mix, which is the core of the energy mix, is the basis for the national electric-power policy and directly affects the expansion of electric-power facilities and the investment plan. Hence, it is important for future planning and development of electric-power infrastructure. In addition, the established electricity mix of primary energy sources has become a major issue in energy policies. Most countries try to build a stable electric-power supply system by planning the optimal electricity mix and designing corresponding policies. To provide a stable electric-power supply, a country generally needs an electricity mix comprising various fuel sources.

Exploitation of renewable energy sources was not easy and expensive in the past while with advancement in technology and large scale production it has now become a viable reality. It facilitates in reducing global carbon emissions and the pace of investment has greatly increased as the cost of technology is in the decline and efficiency continues to rise.

Of course, renewables are an infinite source of power in the Nepalese perspective - the ultimate definition of long-term certainty.

3. Energy Security

As per the global scenario, it is observed that majority of oil and gas sources are concentrated in certain regions, many of which are challenging and expensive to exploit, whereas renewable energy is mostly locally available. It provides security of supply, helping a nation reduce its dependency on imported sources. It plays a significant role in addressing our energy needs by replacing energy imports with clean and reliable home-grown electricity with the added bonus of fantastic local economic opportunities.

Diversity in energy supply contributes to strengthen national energy security. A diversified portfolio of energy assets contributes to a long-term, sustainable energy strategy that protects the power supply from market fluctuations and volatility. Then proverb ‘never put all your eggs in one basket’ is applicable in this context also . That is why it is a wise move to maintain a share of renewable energy in the nation’s energy mix to suggest that a country should not rely on a single source of energy.

Hydropower of different sizes large, medium, mini and micro including run off, peaking and storage; solar, biomass, biogas, bagasse and wind are the various pillars of energy mix composition in Nepal. Technology has brought various renewables into the center of the global energy mix to begin with. It is now offering great prospects for unlocking the untapped energy that remains in different parts of the world.

Nepal aims to achieve universal access to clean, reliable and affordable renewable energy solutions and they are expected to reduce dependency on traditional and imported energy by increasing access to renewable energy.

The use of solar energy is increasing the reliability of traditional electricity in Nepal. Private installations of solar roof top panels are more frequent in urban areas and are used as a backup during the power outages. Recently NEA has formulated guidelines for net metering for domestic and other consumer who have installed solar panel in their premises :

On average, Nepal enjoys 6.8 sunshine hours per day with intensity of solar radiation ranging from 3.9 to 5.1 kWh per meter square, with a commercial potential of solar power for grid connection estimated to be about 2,100 MW.

In 2015, Nepal and the World Bank signed an agreement to develop a 25 MW solar project that will eventually be connected to the national grid and the works at site are in progress regarding its development. It is the largest renewable energy plant under construction in the country. Solar and Wind Energy Resource Assessment project has made an attempt to map the wind resource potential in Nepal and has shown a very good prospect of wind energy with the prediction of about 3,000 MW. Techno-economically feasible capacity of peaking and storage type of hydropower plant is not exactly known yet in Nepal, though various estimations present different pictures.

A community-based solar approach such as solar irrigation pumps, solar mini-grid, solar arsenic water treatment plants, and solar street lights have the potential of benefiting the community people by ensuring food security, arsenic-free pure water, improved socio-economic conditions in off-grid areas and address the consumer load diversity. Some government interventions are urgently required in this area along with focus on policy matters.

4.Diversity in Power Generation

There are many reasons why Nepal shouldn’t rely only on hydro generation, due to the effects of climate change, river-flow may be affected on a long run. In such case relying only on run-of-river hydropower generation may result in different energy generation pattern than expected. Further, civil structures account for around 60 percent of infrastructure in hydropower projects, which are more vulnerable to natural calamities like earthquakes, landslide and flash floods. In the perspective of resilience to natural disasters, solar PV plants which consist of less than 5 percent of civil structures, are less vulnerable to such natural calamities.

From the perspective of generation management, solar energy can play an important role. Contrary to current trends, solar can be used to serve the daytime base load and water in peaking ROR can be saved to meet the evening base and peak load. The necessity of diversifying the energy mix has also been emphasized by the "National Energy Crisis Mitigation Plan and Ten Year Electricity Development Plan 2016", which has envisioned an energy scenario of 40-50 percent from reservoir-type or pump storage hydro, 15-20 percent from peaking run-of-river hydro, 25-30 percent from run-of-river and 5-10 percent from other renewable energy sources like solar/wind. The white Paper published in 2018 by Ministry of Energy, Water Resources and Irrigation has reviewed this energy mix composition as follows:

Reservoir and Pump Storage: 30-35 percent, Peaking Run of the River: 25-30 percent, Run of the River : 30-35 percent and Renewable/Alternative Energy: 5-10 percent

Energy portfolio diversification is key for sustainable electricity supply. If there is short fall in one source, then other source can sustain the supply.

Centralized distribution is known to be affected by transmission and distribution losses, whereas a distributed system can be set up to transmit to regions near the sources.

The recent "Grid Connected Alternative Energy Development Guidelines 2074" published by Ministry of Energy, Water Resource and Irrigation has specified that Power Purchase Agreements (PPA) will adhere to a flat rate of Rs. 7.30/kWh, for electricity from solar, wind and biomass sources with no provisions to escalate this rate. This rate was fixed based on the current average posted rate applicable for RoR hydropower.

In order to manage a stable supply, Nepal needs to shift from hydro dependence and achieve a healthy energy mix employing different renewable technologies. Thanks to its topography, Nepal can achieve a stable, reliable, sustainable, efficient and affordable energy which can be achieved through optimal utilization of available renewables with appropriate energy mix.

5. Cogeneration as a New Source to the Electricity Mix

Harnessing electricity through cogeneration stands as a promising new source in the electricity mix of Nepal. Nepal government and NEA have already set the policy framework required for harnessing electricity through cogeneration for self-consumption and selling the surplus to the national grid in harnessing cogeneration from sugar industries.

6. Wind and Solar Power

Wind and solar are less prone to large-scale failure because they are distributed and modular. Distributed systems are spread out over a large geographical area and a severe weather event in one location may not disrupt power of an entire region. Modular systems are composed of numerous individual wind turbines or solar arrays. Even if some of the equipment in the system is damaged, the rest can continue to operate.

Renewable energy sources (RES) have significant potential to contribute to the economic, social and environmental energy sustainability i.e naturally replenished, energy efficiency and long term availability

However connecting renewable energy to the power grid will impose new challenges. Local issues such as steep power fluctuation, voltage stability, voltage control, harmonics and capacity are the areas that need to be studied in the context of Nepal.

Reliable energy trading and energy banking as well as maintaining environmental sustainability through the development of renewable energy mix in the systems is a urgency. Although technology exists today to handle the challenges, we must accept the bitter truth, though unwillingly, that we have become unable to integrate renewable mix as desired.

7. Way Forward

Nepal's power system is predominantly hydropower-based. However, there are positive indications that Government of Nepal has started to focus on the development of renewable sources, too. To pursue this, Nepal needs to have a coherent energy policy to utilize various sources of renewable energy as may be economically viable.

That's why it's high time to access an optimal mix of energy generation from energy security perspective which is suitable for Nepal. Energy security should be evaluated by taking into consideration market dynamics prevailing in the country and the quantum of energy not supplied due to system disturbance which can be one of the several criteria for its determination.

Unless an optimal mix of energy generation is enforced through a national policy, the power sector development agenda cannot gain full momentum towards attaining energy security in the country.

Non-Technical Losses: Identification and Efforts by NEA

Ranjan Raj Gurung
Assistant Manager, Planning and Technical Service Department, NEA

NEA seems convinced that electricity theft is the most prominent form of non-technical losses while customer non-payment can also lead to significant loss. In the recent white paper issued by Ministry of Energy and water resources, an ambitious target has been set to bring down the annual loss below 15 % by 2022 A.D.

Power system losses can be divided into 2 categories, Technical and Non-Technical.

Technical losses mean losses that happen because of the physical nature of the equipment and infrastructures of the power systems i.e. I2R losses or Copper losses in the conductor, cables, transformers, switches and generators. Technical losses can be calculated based on the natural properties of components in the power system such as resistance, reactance, capacitance, voltage, current and power. Such losses are possible to compute and control, provided the known quantity of electrical loads.

Non-technical losses on the other hand, are caused by actions external to power system or are caused by loads and conditions that technical loss computation failed to take in to account. Non-technical losses are more difficult to measure because these losses are often unaccounted for the utility like NEA and thus have no recorded information. The probable causes of non-technical losses are:

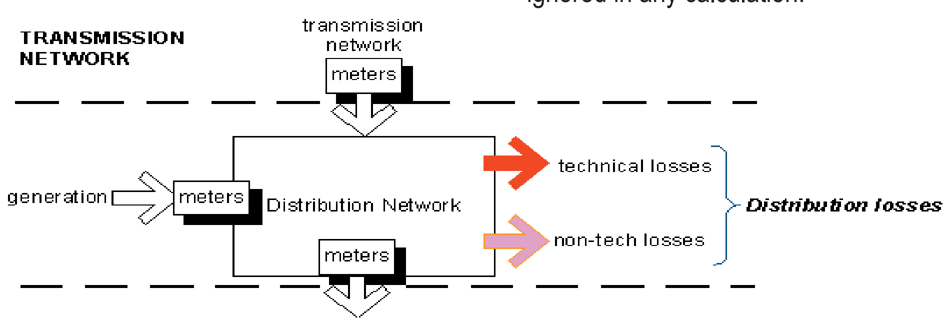
1 Electricity theft

2 Non-payment by consumers

3 Error in technical loss computation

4 Error in accounting and record keeping that distort technical information

5 Equipment deterioration overtime that causes unanticipated increase in system losses but are usually ignored in any calculation.



Power flow and loses in power system network

1 and 2 are prominent causes and 3, 4 and 5 are system miscalculation usually conducted by NEA personnel and working culture.

Non-technical losses are difficult to quantify as the people who make illegal connections to the distribution grid are unlikely to participate in any kind of query or survey regarding losses freely when their own illegal actions would come to light. Other case of non-technical losses may be the component breakdowns such as, due to electrical equipment struck by lightning, equipment damaged by times that drastically increase losses before they are replaced in time. Losses by equipment breakdown are quite often in NEA as electrical equipment breakdown and lacks some form of maintenance policies regarding such equipment.

Electricity Theft

A conscience attempt by person to reduce or eliminate the amount of money he or she will owe the utility for electric energy. This could range from tampering with the meter to create false consumption information used in billings to making unauthorized connection to the distribution network.

Methods of Electricity Theft

Both HV meters and LV meters are tampered in the following ways.

High voltage meters
(11 kV, 3 phase, 4 wire primary)

HV meters are installed by NEA to monitor loads that consume high volume of energy requiring high voltage. Because the load is connected with high voltage and consumers high current levels, the current and voltage sensing are achieved by using CT/PT or some voltage taps. Some methods of tampering HT meters are as follows:

Tampering with terminal seals

It is the most common method of meter violations because the terminal seals are easy to reach, located immediately below the meter itself. Once the terminals are broken, it is simple to connect one of the control wires or CT wires to ground making it appear to the meter that at least one phase does not show voltage or current. This refer to no visible tampering of meter or meter terminals.

Breaking control wires

Control wire refers to the secondary wires of the CT. Meters for larger loads measure high currents and most use CTs to step the current level down to make it compatible with components of meter. Once the insulation of control wire is broken, external taps would be connected to reduce current going in to the meter, causing the meter to read less current than reality.

Tampering with the meter seal

Tampering with the meter seal make easy access to the inside meter the housing and there are several things that can be done to slow or stop meter readings. In case of TOD meter, reverse connection may be possible that causes the meter to read less until and unless the meter is downloaded and analyzed for additional billing.

Shorting control wires

Like breaking control wires, this could divert the current reading of the meter. In this case, the current going in the meter would be zero. Obviously, the power and energy readings become zero.

Breaking PT connection or voltage taps

PT or voltage taps in the meter housing allows the meter to read voltage of the load. Once they are broken or shorted to ground or have another line connected to it, the reading of the meter get distorted from reality, reading lower energy and in electricity theft. This may damage the meter because the internal equipment of the meter must operate within the rated conditions in order to function properly.

Direct connection to the grid

It is the act of bypassing the meter. Often, customer request the high voltage line such as 11 kV to run to the back of their property, to keep front clear and safe, this may help to influence people to tap the grid directly.

Tampering with the meter

Once the meter seals are broken, several things can be done some of which are as follows:

Mechanically obstructing the spinning disc and the axial rod that does the recording of energy.

Turning back the dials (counters) that bill collectors eventually. This wouldn't work for digital display meters.

LV meters (230 V single phase)

Such meters are more common and are issued by NEA to the domestic consumers and small businesses. Some of the malpractices regarding electricity theft are as follows:

Direct connection to the power grid

Since meters operate in 230 V system, a direct connection to the distribution grid is much easier than high voltage system.

Using alternate neutral lines

Using different neutral with respect to the live line reduces the voltage level that is passed to the meter. This can be done by connecting the small transformers to the neutral line that is grounded hence reducing the voltage passing to the meter.

Meter tampering or breaking seals

It is basically same as HV meters.

Others methods may be tapping off a nearby paying consumer, damage done to meter enclosures, using magnets to slow down spinning disc.

Non-payment by consumers

Like electricity theft, non-payment by consumers is also a non-technical loss to the NEA as it obstructs bringing revenue to the organization. NEA has provision of disconnecting line and blacklisting such consumers. The main causes of the problem are as follows:

- Inability of NEA to disconnect the supplies for non-payment
- Unsustainable subsidies installed by GoN
- Poor corporate governance
- Declining incomes, high inflation, high unemployment, rising energy prices severely eroding household ability to pay for energy.
- Some government offices that cannot be disconnected despite continuous non-payment
- Threatening to NEA staffs for disconnection
- Non cash payment also provides another way for officials to personally profit, resulting in stagnant cash collection rates.

Other reasons for the losses may be the absence of adequate metering and poor location of meters.

Meter Inspecting Protocols of NEA

NEA policy for billing customer who committed electricity theft (source: Electricity Pilferage Control Regulation 2059):

S.No.	Billings and fines	Target/ time frame
1	Calculated loss unit + compensation equal to 100 % of the loss unit	To be paid by the customer within 35 days of receipt of notice
		If customer does not pay within given timeframe, the distribution center chief should file the case to the district court within 30 days of end of given timeframe.
		If the court decides against the customer indulged in electricity theft, he/she has to pay fine and additional NRs.5000.00 and 3 months imprisonment
2	If the same customer indulged in theft for the second time, calculated loss unit + compensation equal to 200 % of loss unit	To be paid by the customer within 35 days of receipt of notice
		If customer does not pay within given timeframe, the distribution center chief should file the case to the district court within 30 days of end of given timeframe.
		If the court decides against the customer indulged in electricity theft, he/she has to pay fine and additional NRs.10,000.00 and 6 months imprisonment.

Sometimes, additional billing has to be done due to CT/PT outage, Multiplication factor (MF) error and reverse energy due to misconnection. Such additional amount has to be paid by the customer within 35 days of receipt of notice otherwise the NEA will charge fine as on regular dues.

Meter inspection schedule of NEA (source: Electricity Distribution Bylaws 2069)

S.No.	Item	Goal/schedule
1	66 kV, 33 kV and 11 kV consumer above approved load of 200 kVA	Commissioning and downloading in every 3 months
2	11 kV consumers below approved load of 200 kVA and other LV consumers with TOD meter	Commissioning and downloading in every 6 months
3	LV meters, 230 V and 400 V	Resealing and inspection every months/ as per requirement

In the similar way, NEA should conduct the scheduled operations for the following cases also as an effort to reduce its non-technical losses:

- Routine check for meter with past violation and suspicious business groups
- Major consumers with recent meter installation or changes
- Checking large consumer with irregularities
- Checking meters with zero unit reading
- Replacing 4 digit meters, clock type meters, stopped meters on regular basis
- Other approaches that should be done by NEA are as follows:
- Adequate metering in feeders, substations, and consumer blocks is essential to prevent electricity theft.
- Organization of commercial functions such as meter reading, collection of revenues, customer accounting and follow up.
- Elimination of intermediaries should be done as they artificially create non-payment of energy. Online payment system may eliminate the case somehow.
- Incentives to the NEA staff should be provided who are involved in controlling electricity theft and collection of revenues.
- Special price discount should be given to the large consumer motivating them to pay the bill in advance.
- The file for additional billing due to reverse connection, CT/PT outage, MF error etc. should be calculated, analyzed and approved on time.

NEA is now effectively implementing programs for the non-technical loss reduction. Launching of smart meters will be one of the biggest moves towards it. As a technical staff of the organization, I hopefully request all the staffs of NEA to join the campaign for its good financial health, better public reputation and overall wellbeing of its stakeholders.

GIS based System for NEA DIstribution Utility Merits of its Application

Sumit Sadam Bala
Engineer, Pokhara Regional Office, NEA

Our System at a Glance

Although there has been some private penetration in Electricity Generation sector of Nepal, Nepal Electricity Authority still has the sole responsibility in Transmission and Distribution along with Consumer Services apart from some parts in Western Nepal where a public entity Butwal Power Company (BPC) has also been working in all three sectors of the electrical utility. According to Yearbook of NEA FY 2016/17, only 65% of the population has access to grid electricity and in terms of area, a huge part of rural Nepal is still yearning for grid electricity. In the region within reach of grid electricity, a total of 109 Distribution and Consumer Service (DCS) entity of NEA divided to 7 Regional offices under Distributed and Consumer Services Directorate are working for new electrification, repair and maintenance and consumer services related activities. Among these very few entities have partly implemented or are in the process to incorporate GIS-based system and none have fully implemented the GIS-based system.

What is GIS?

GIS, an acronym of Geographical Information System, is a tool which integrates of geo- referenced data using some hardware (laptop, desktop, tablets, mobile) and proper software for displaying, managing and analyzing those data. In simple words, if you plot your data in globe or map and you can use that data to view, query, understand and thus use it to develop plans for new projects and solve problems then it is the GIS-based system. There are many forms of charts and formats to represent data but when the data is viewed in geographical perspective then the understanding of the data is more vivid and real.

How can GIS help NEA DCS?

With the advancement of information technology, GIS has become a basic tool for all kinds of data visualization and analysis. NEA DCS can highly benefit from the implementation of GIS. The most basic step to finding the solution for all the problems and challenges that NEA DCS has been facing is putting an end to impromptu decision making amidst the availability of huge data volume. And for that GIS is the right tool. The GIS-based technique can be integrated into any enterprise.

- **Network Mapping and Visualization**

The first step to the GIS-based system is the mapping of the current electrical network of each DCS. Almost all DCS have the data of 33kv Substations and load centers in some format. By getting the right geographical coordinates this can be plotted and mapped on a globe or map. Along with this, the location of HT and LT poles and the path of HT and LT lines can be done in any GIS software after collection of field data. Consumer indexing can help to properly monitor

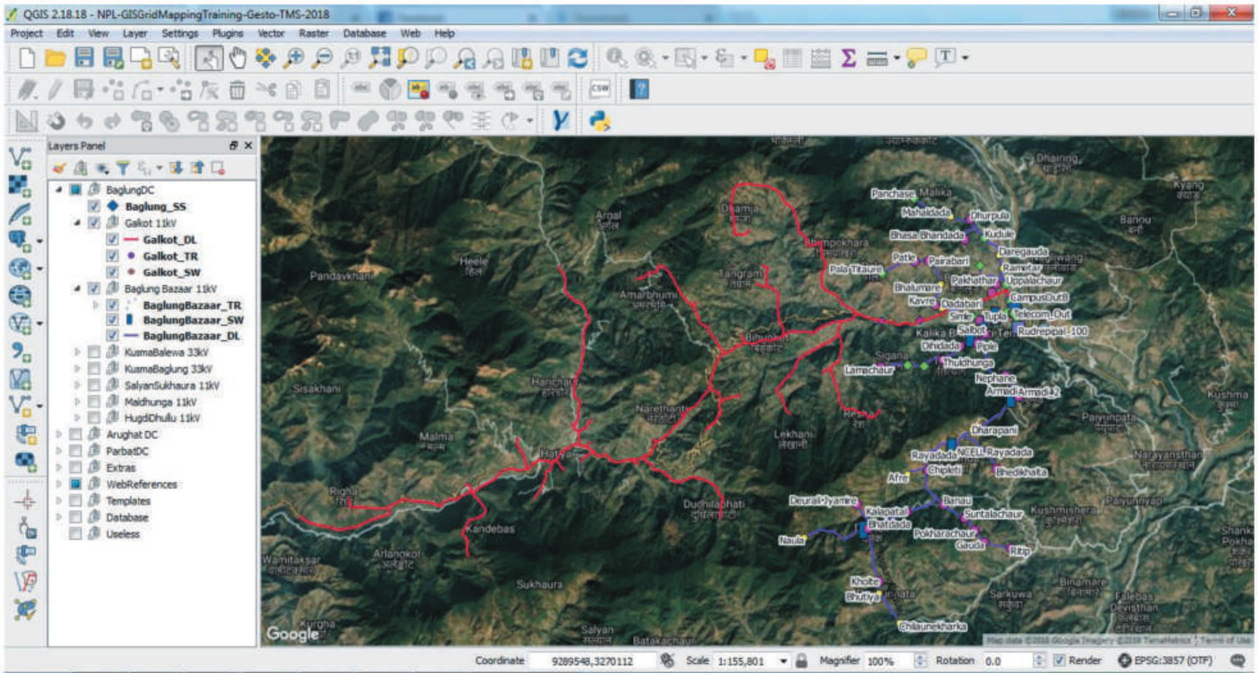


Figure 1 GIS Mapping using QGIS (Free and Open Source GIS software)

and speed up the consumer service activities. This will help to visualize the vastness of the network and a proper visualization is the first step to locate the problem and thus find the steps towards solutions. Data viewed in terms of geography can be understood with ease and quickly shared for immediate action.

- ## Data and Asset Management

The GIS-Based data management can be pivotal in the data management sector of NEA DCS. Everyday DCS directorate collects huge data from every nook and corner but the record is not stored properly. It has been a regular job to ask for same data again and again which can be considered deficiency of proper data management. By implementing the GIS-Based system in proper software the data can be recorded and digitized for all events. This will also be the basis for Asset management of NEA DCS. By proper and detailed GIS-based record of Substations, land area, Load Centers, Poles, conductors and other line materials, the vast assets of NEA DCS can be easily visualized and recorded for any future reference and analysis.

BaglungBazaar_DL :: Features total: 20, filtered: 20, selected: 0

	Feeder_Nam	SubStnOrig	FeederCd	Rating_kV	CondSz_Nam	CondSz_Num	Status	Under_Over
1	BaglungBazaar	Baglung	BAGBAZ	11	Rabbit	50.00000	In Service	over
2	BaglungBazaar	Baglung	BAGBAZ	11	Rabbit	50.00000	In Service	over
3	BaglungBazaar	Baglung	BAGBAZ	11	Rabbit	50.00000	In Service	over
4	BaglungBazaar	Baglung	BAGBAZ	11	Rabbit	50.00000	In Service	over
5	BaglungBazaar	Baglung	BAGBAZ	11	Rabbit	50.00000	In Service	over
6	BaglungBazaar	Baglung	BAGBAZ	11	Rabbit	50.00000	In Service	over
7	BaglungBazaar	Baglung	BAGBAZ	11	Rabbit	50.00000	In Service	over
8	BaglungBazaar	Baglung	BAGBAZ	11	Rabbit	50.00000	In Service	over
9	BaglungBazaar	Baglung	BAGBAZ	11	Rabbit	50.00000	In Service	over
10	BaglungBazaar	Baglung	BAGBAZ	11	Rabbit	50.00000	In Service	over
11	BaglungBazaar	Baglung	BAGBAZ	11	Rabbit	50.00000	In Service	over

Figure 2 Feeder Data Management using GIS Software

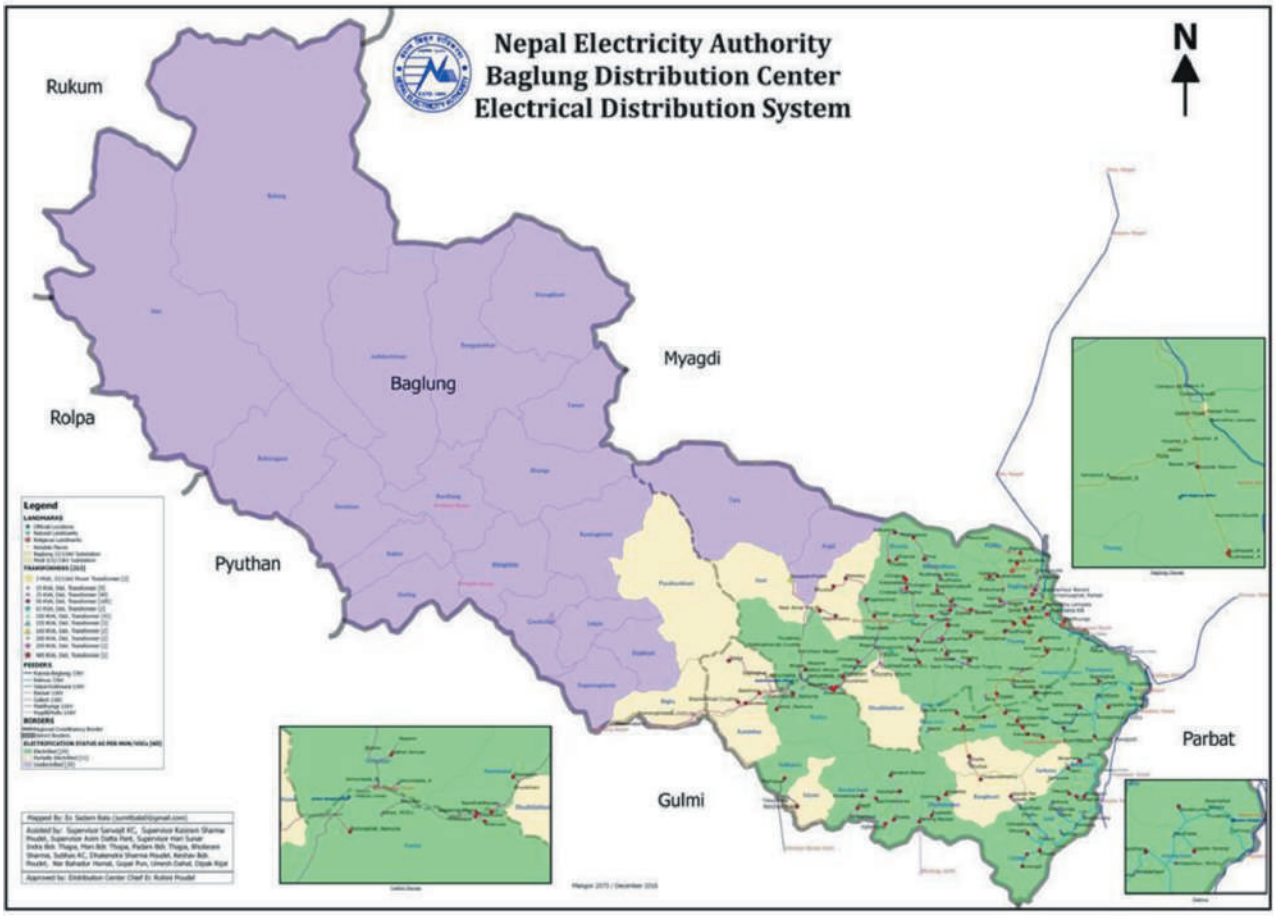


Figure 3 Composed Map of Baglung DC Distribution Network (Mapped by Sadam Bala)

- **Work Planning and System Analysis**

DCS can use GIS-based system to manage and map kilometers of underground or overhead conductors and its surrounding and schedule repair and maintenance activities accordingly. By plotting the population and settlement data, planning for new load centers and vegetation management can be done with much ease and accuracy. By incorporating DCS utility assets with consumer indexing and information, the GIS-based system can proactively be used to monitor loss control activities, manage any work orders, and system outages. Electrical simulation and analysis software with GIS-based facility can be used to identify vulnerabilities and accurately plan system improvement work, fault and outage reduction, voltage drop and loss improvement.

- **Automation and Richer Communication**

The GIS-based system with workforce automation will help to efficiently schedule and dispatch DCS staffs and hence increasing the productivity. Street level routing can be done to schedule the work for consumer service and routine maintenance.

Through GIS-based graphical output and web-based reporting, the management can be aware of the real-time situation of the network in case of system outage or fault and handle the problem meeting the required reliability compliance as well. The GIS-based system can thus promote richer communication and management of DCS activities.

Brief Introduction of Drilling Equipments and Accessories

Indra Kumar Bishwokarma
Engineer (Mechanical), Soil, Rock and Concrete Labrotary, NEA

Introduction

Diamond core drilling is the process of digging inside the earth crust. Where solid cylindrical material is dug-out for geotechnical investigation. It has revolutionized the study of Rock conditions inside the earth surface. Core drilling is also carried out for the discovery of many minable ore bodies that would otherwise have gone untapped. In the context of Nepal,it is mostly done for hydropower project construction study and survey. The core drilling works in Hydropower survey varies from few meters to Five hundred meters depth but up to 350 meters is common. The drill-hole diameter varies for different bits and drill pipes series.

Core drilling works requires drilling rigs, pipes, bits, water swivel, hoisting swivel, wire-line, tripod, core barrel, water supply systems etc. The Core drilling works is a complex task. Experienced driller, skilled labor, Geologist, Mechanical Engineer, and Mechanicswork as a team for coring and analyzing the result. Here, Geologist has the main role to analyze the result obtained from core drilling. The Mechanical team is responsible for all arrangements like selection of machines, bits, pumps etc.,and to carry-out drilling work at the sites. Every member of team should have brief knowledge of drilling equipment and accessories for efficient drilling.This article mainly focuses on describing drilling equipment and accessories.

Drilling Equipment and Accessories

Core drilling works requires varieties of tools, accessories, rigs, pumps etc. The major equipment and accessories are shown in schematic diagram as in Figure 2.1.

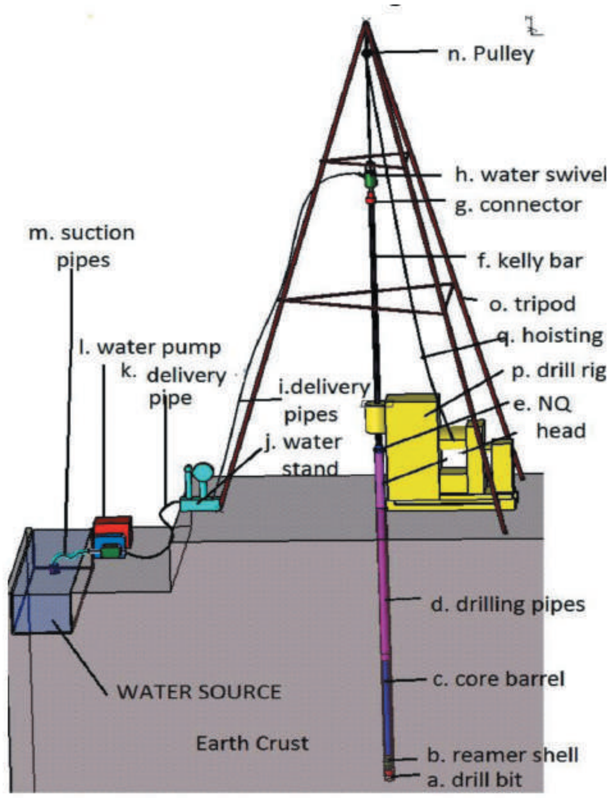


Figure 2.1: Schematic of drilling set up

The level in each part shows the positions of those accessories while drilling.

From the schematic diagram, it is clear that water is pumped from the water source and delivered to the water stand via PVC pipes. Water stand contains the flow meter, pressure gauge and the by-pass control valve. By using it, one can set the required flow rate and pressure. The delivery pipe carries the water from water stand to water swivel. Water swivel is connected with Kelly bar. The water from Kelly bar reaches the drill bit via connector, rod, core barrel, and reamer. This water circulates back to top while carrying out cutting during core-drilling and it also act as a coolant and lubricant for the drill bit.

Similarly, the rotational energy from the engine is transferred to the spindle via coupling. The spindle is engaged or disengagedbyusing clutch. When engaged, the energy from spindle is transferred to Kelly bar; the Kelly bar not only rotates but also gives feeding pressure to the bits. This rotation and feeding energy is transferred from Kelly bar to the bit via connector, rod, core barrel, and reamer.

Brief introduction of each equipment and accessories is described below:

Drill Rig

Drill rig is a machine which drives the drilling works. There are verities of core drilling rigs in the market. Drilling rigs can be massive structures or they can be small enough to be moved manually by one person. The size of rig increases with the increase in its drilling capacity. Drilling rigs can be mobile equipment mounted on trucks, tracks or trailers, or may be permanent land or marine-based structures.

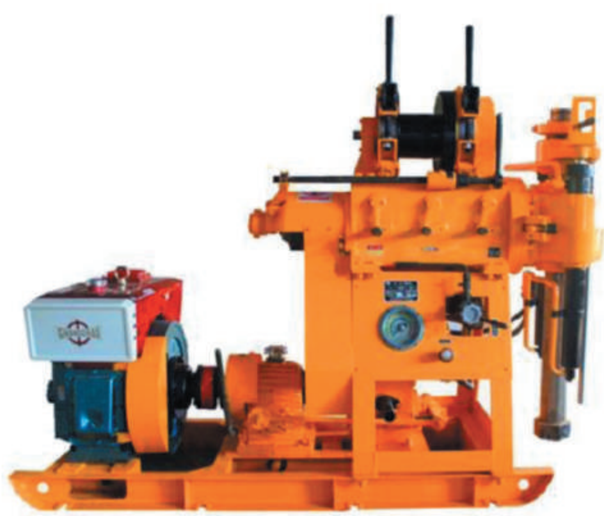


Fig 2.2: Drill Rig

In Nepal scenario, drilling works are mainly carried out in hilly, remote region with no access to roads for transportation. In such situation, machines are dismantled into small pieces and carried to site manually. Thus while selecting rigs, one need to pay special attentionto maximum weight of each component.

In case of core drilling for geological investigation, the depth of drill-hole requirement varies from few meters to five hundredmeters. The table below shows the important parameter for the selection of drill rig for various ranges of drilling capacity.

S.N.	Capacity (in meters)	Required Spindle Torque (KN-m)	Required lifting pressure (in KN)
1	Up to 50m	0.8-1.2	20-25
2	50 to 100m	1.2-2.0	25-30
3	100 to 200m	2.0-2.4	30-40
4	200 to 300m	2.4-2.8	40-55
5	300 to 500m	2.8-3.4	55-70

Source: Assembled data from various drill manufacturer's website

The spindle torque is directly linked to engine capacity of drill rig. It sets the requirement of engine capacity. Similarly, the lifting pressure sets the capacity of hydraulic pump.

Water Pumps

Water pumps are used to support the drilling works. It flushes out the cuttings and mud from the drill holes. Thus it is also called mud pump.

Fig 2.3 : Mud Pump

The water from the pump not only flush-out the cuttings from the hole but also lubricate, and cools the drilling bit. Thus, proper selection of pump lead to better bit life and efficient drilling.

The flow-rate of water and the pressure developed from the pump are the important parameters in the selection of mud pump.High pressure is required for core drilling, thus reciprocating triplex piston pumps are used. The table below shows the general requirements of flushing rate (in liter per minute) of pumps over various bit sizes and rock hardness.

Types	AQ	BQ	NQ	HQ	PQ
Very hard	14-18	23-27	27-36	36-41	45-50
Hard	18-23	23-36	36-50	45-54	55-60
Other	27-36	32-45	56-64	64-73	68-77

Source: [2]Where, AQ, BQ, NQ, HQ, PQ = standard bit sizes

Drill Bit

Drill bit are the tools to cut the rock. It covers the major portion of cost for drilling works. The selection of drill bit is a complex task. The performance of bits depends upon the rock type, spindle speed, cutting pressure, feeding pressure, flushing rate and skill of driller etc. The price and quality of bit depends upon percentage of diamond impregnated over binding materials, quality of diamond, Crown height and type of water ways.

Fig 2.4: Drill bit

There are various size and standard of drilling bits in the market, the most commonly used standard are BQ, NQ, HQ, PQ. Table below shows the sizes of these standard bits.

S.N.	SIZE	C.D. (mm)	O.D. (mm)	I.D. (mm)
1	AQ	27	47.75	27.1
2	BQ	36.5	59.69	36.52
3	NQ	47.6	75.44	47.75
4	HQ	63.5	95.76	63.63
5	PQ	85	122.30	85.09

Source: [2]

Note: C.D.= core diameter, O.D.= outer diameter, I.D.= inner diameter

The detail description of bit selection, their properties and handling methods are already explained in article published in previous Bidhut edition.

Casing Shoe

Casing shoe are also called as casing shoe bits. They have similar function as drilling bit. The casing shoe bits are connected to the end of casing pipe. Various series and standard of casing shoes are available in the market. Mostly used standards are AW, BW, NW, HW and PW. Table below shows the dimensions of different standard sizes.

S.N.	Bit Standard	OD (mm)	ID (mm)
1	AW	59.69	48.26
2	BW	75.44	60.38
3	NW	91.95	75.95
4	HW	117.65	101.09
5	PW	143.76	122.94

Source: [2]

The different parameters and selection criteria are almost similar to that of drilling bits.

Drilling Pipes

Drilling pipes are hollow thin-walled steel cylindrical pipes. Hollownessallows drilling fluid to pump down the hole through the bit and back up the annulus. It is available in a variety of size, strengthand wall thickness. Generally, 0.5m, 1m, 1.5m, and 3mare used. Its strength and wall thickness depend upon the drilling torque required to transfer from rig to bits via core barrel and reaming shell down the earth crust. The table below shows their dimensions as per their different standard sizes.

S.N.	Sizes	OD(mm)	ID (mm)	Weight*
1	AQ	44.5	34.9	14
2	BQ	55.6	46	18
3	NQ	69.9	60.3	23.4
4	HQ	88.9	77.8	34.4
5	PQ	117.5	103.2	47.2

* weight (kg/3m) may varies over the manufacturer Source: [2]

Drilling pips are mounted on Kelly bar via connector called head.

Casing pipes

Casing pipe is similar to drill pipe. They are fitted with casing shoes. They are generally used to provide the wall support for the drilling pipes so that the soil, sand,

Fig 2.5: Drill Pipes

sandstone do not fall into the hole from the side wall.

The table below shows the dimensions of different standard sizes.

S.N.	Sizes	OD (mm)	ID (mm)	Weight*(kg)/3m
1	AW	57.1	48.4	17.2
2	BW	73	60.3	31.8
3	NW	88.9	76.2	38.4
4	HW	114.3	101.6	50.5
5	PW	139.7	127.0	64.3

* weight may varies over the manufacturer Source: [2]

They look similar to drilling pipe, but their thickness and size are little bigger than drilling pipe.

Core barrel

Core barrel is the accessory connected to the drilling pipe. It contains two parts, one is the rotating cutting part and another is non rotating tube part. Rotating part is fitted with reamer and the bits and non -rotating part holds the core. It is generally made of steel and is single, double and triple tube type of 1.5m or 3m length.

Fig 2.6: Tripod (Source: [1])

Water Swivel

Water swivel is connected to the upper most portion of drill rod. They are hung on tripod pulley. It mainly contains two parts: one rotating part, connected to drill rod of Kelly bar and another stationary part connected to delivery pipe. It supplies the flushing water from stationary pipe into rotating drill rod.

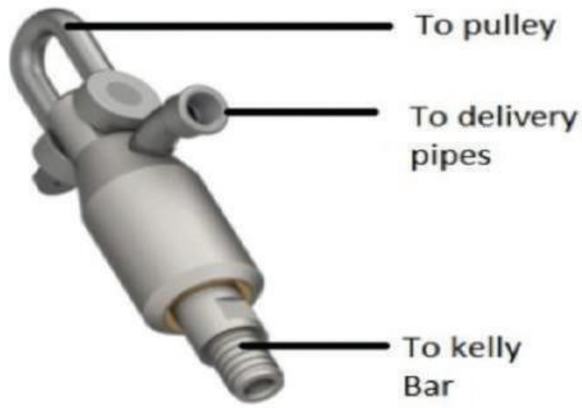


Fig 2.7:Water Swivel (Source: [1])

Hoisting swivelsare used to remove drill pipe out of the drill hole. It is fitted at the same place by removing the water swivel.

Tripod

Tripod is the stand made of three cylindrical steel pipes. It provides full support for hoisting the drilling pipes. It is generally 7m in length and each pipe are 3 inch in diameter. The strength and size of tripod mainly depend upon the required drilling depth. Figure 2.6 shows the tripod.

Other Accessories

There are large number of accessories required for drilling works. Each item plays an important role in core drilling. Few of the important parts are shown in figure below:

Drilling Process

Diamond core drilling work means basically to dig out rock sample from the earth crust. It involves other DCPT, Seepage tests etc. Here are the basic steps for the core drilling works:

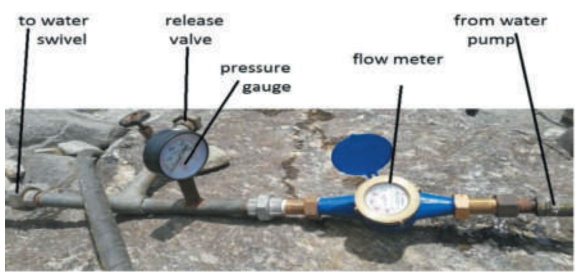


Fig 2.8: Water stand


Fig 2.9: Reamer Shell Fig 10: head (connector)


Fig 11: Core box   Fig 12: Chain pulley


Fig 13: Tools   Fig 14: Foot Clamp [1]

First, the Geologist locates the drilling points as per investigation requirements.

Equipment and accessories are transported to the drilling sites.

The drilling platform of approx 4m×5m size and 3m height is made and the machine is assembled as shown in above fig 2.1.

After this, water from the pump shall be checked whether it is reaching the water stand or not.The water stand contains the pressure gauge and flow-meter. Check whether the required flow rate and pressure has been achieved of not. Keep open the by-pass valve.

Start the drill rig,without engaging the spindle.Connect the drill pipes at Kelly bar via head and connect the reamer the core barrel at the other end. At the end of core barrel connect reamer and next to it connect the drill bit.

After completion of this set-up, now it is ready for drilling works. For starting drilling, engage the spindle, close the by-pass valve in water stand and give the feeding as recommended. This will start cutting the core. The core will be stored in inner stationary tube of core barrel.

When around 2 m (as per used core barrel) length is penetrated, disengage the spindle from gearbox, then open the by-pass valve of water stand. Pull up the pipe using hoisting,take out the core barrel and collect the core sample and place it in core box.

Add additional pipe, join the core barrel and again start drilling and repeat step g.

If the side wall of the hole is not firm, it is necessary to put the casing. To do so, the casing pipes are connected to the Kelly bar, and its other end, the casing shoe bit are connected. Hence, there is no need of core barrel and reaming shell as it doesn't take out the core sample but only increases the hole diameter. With increasing depth, keep on adding additional casing pipes.

Keep the casing in the hole, and perform core drilling as in step g. Repeat step g and step i till the required depth is achieved. Take out the drilling pipes, core barrel and casing pipes after the completion of core drilling. Dismantle the set-up. Don't forget to put the mark on drill hole. Some driller marks the drill hole by concreting the top surface of hole.

Conclusion

Core drilling is done for geological investigation. It requires group involvement mainly driller, geologist and mechanical engineer. Each member should have brief understanding of major drilling equipment and accessories for efficient drilling. This article describes in brief about Drill rig, water pump, drill bit, drill rod, casing shoe, casing pipe, core barrel and water swivel etc. This article also enumerates the basic steps of drilling works. Thus, this article could be an important resource for one who wishes to understand about drilling equipment and accessories and their basic selection process in brief.

Acknowledgement

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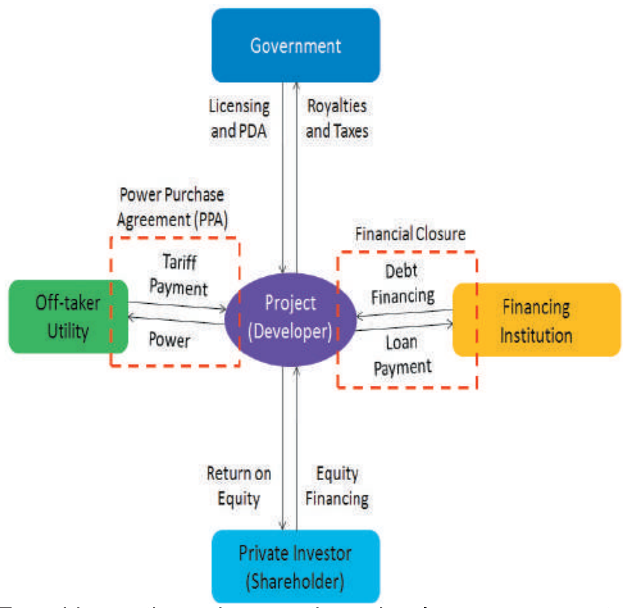
Bankability Concerns of Power Purchase Agreement through Various Perspectives

Mandira Adhikari
Engineer, Power Trade Department, NEA

1. Background

Developing a hydropower project involves huge investment. To arrange for huge investment as such, hydropower developers approach financing institutions either at local level or at international level. If a project or proposal is attractive from different perspectives such as politically, economically, socio-culturally, technologically, legally, and environmentally, it becomes much easier to arrange for funds. Any project or proposal, which is attractive to investors, is considered Bankable. Understandably, higher Return on Investment (ROI) becomes the prime motive of any investment. Therefore bankability becomes the utmost concern for every investor.

Broadly, there are three key players in a power development project, i.e., developer, offtaker and investor. Each of them has different motives for developing a hydropower plant. For a developer, prime motive is to generate more power, which can be cashed by selling energy to offtaker at an attractive tariff. For an offtaker, buying adequate power, which can easily address prevailing energy demand, is more important and, of course, the tariff should be affordable to the offtaking entity. Likewise, for a financing institution, key concern would be whether developer can pay back loan at a said time-period or not. A typical relationship between developer, offtaker and investor is depicted in figure below:



To address the prime motive, developers carry out feasibility study comprehensively and approach offtaker to enter into a contractual document more commonly known as Power Purchase Agreement (PPA), which ensures that power generated will be bought by the offtaker. Essentially, PPA terms and conditions are one of the fundamental criteria for financing institutions to invest in hydropower projects apart from the credibility of the debtor and project financing risk assessment. Delving into the scenario closely, we can see that the common interest of all these players would be sufficed through optimum power generation at a said/agreed time.

In context of Nepal, major stakeholders in hydropower sector are Ministry of Energy, Water Resources and Irrigation, Nepal Electricity Authority (NEA), an undertaking of Government of Nepal, and Independent Power Producers (IPPs). Under Ministry of Energy, Water Resources and Irrigation, Department of Electricity Development (DoED) mainly issues survey/generation licenses to power developers. Similarly, NEA has been playing a lead role in fulfilling electricity needs of the country through generation, transmission, distribution, and trading of power. IPPs entered Nepalese power market in 1996 A.D. when the first PPA was signed between NEA and Himal Power Ltd. to purchase electricity generated from Khimti Hydropower Project (60 MW). Since then numbers of IPPs have been actively participating in generating power at present. Along with this intervention, NEA's monopoly ended in generation side. While in contradiction, all the power generated in the country is still being transmitted, distributed and traded via NEA. In this sense, we can say that in Nepalese power market, PPA acts as a powerful tool to bring developer, investor and offtaker together for developing a hydropower project.

The untapped hydropower potential of Nepal is notably large. However, the investment in this sector is relatively inadequate. Developing a hydropower project in Nepal is difficult due to political, financial, social, technical, legal, and environmental challenges. The sluggish development of hydropower sector justifies it further. Development in the hydropower sector has larger impact in GDP of the country. So, to exploit the hydropower sector completely, it becomes necessary to create investment-friendly environment and PPAs have to be bankable to lure more players into the power market.

2. Major Bankability Concerns of PPAs

At present, there are 258 PPAs singed between NEA and IPPs. Theoretically, PPA guarantees that energy generated will be bought by an offtaking entity. However, in actual scenario, there are various other issues that are beyond the control of PPA. Quite a number of times, bankability issue comes up for discussion among developers and investors. What can be the reason that hydropower business becomes so debatable at times? Let us look into some of the bankability concerns of PPAs and how they are being dealt with in the Nepalese power market.

2.1 Power Evacuation Risk

In Nepal, status of transmission line and substation is poor at various locations. Projects are not completed in time due to various obstructions such as local disputes, contractual issues, poor mobilization of fund and other resources, sluggish decision making process, EIA/IEE and tree cutting issues. Therefore hydropower projects tend to delay their part of works to match the pace of evacuation facility. To address power evacuation issue, PPAs have penalty clauses under which defaulter is obligated to pay penalty to other party. In some cases, contingency arrangement, i.e., alternative evacuation mechanism is decided upon to evacuate generated energy. Such arrangement eases up the problem somehow but there are times when power cannot flow at full capacity.

2.2 Hydrological Risk

After obtaining survey license from DoED, hydropower developers prepare Detailed Project Report (DPR) where project charter and scope are clearly described. This is a crucial stage as the study determines how much energy can be generated from the project and, based on the same, the power and energy are to be contracted through PPA. All other clauses in PPA are for supporting the energy quantum delivery and offtake. It has been observed many times that, in order to rush into signing PPA, DPR is often carried out with negligence. Hydrological data availability is another serious issue. Department of Hydrology and Meteorology (DHM), which is an authorized Government entity to carry out hydrological and meteorological measurements, has published data only upto 2010 A.D. and for some locations, data are available only upto 2006 A.D. Likewise, sufficient gauging stations are also lacking. Most of the time energy calculation done with outdated data leads to inconsistency with actual data. After successful commercial operation of projects, projects start delivering energy to the national grid. Poorly conducted DPR affects developers at this point where developers face problems during energy availability declaration, which is normally submitted one month earlier to offtaker. For projects above 10 MW installed capacity, developers are allowed to declare energy quantum at least 90% of contract energy in dry season and 60% in wet season for upcoming month and for below 10 MW projects, the limit of availability declaration is 50% of the installed capacity all year round. There are cases when projects have hard time meeting declared energy. Failure to generate declared energy attracts penalty clauses. Likewise, in cases where energy declaration is done for energy more than contracted one, energy difference is treated as excess energy to which only 50% of the posted rate is payable. Even at offtaker's side, poor energy estimation highly affects the energy planning activities of the offtaking entity. Therefore DPR should be carried out comprehensively to enhance bankability of PPA from investment point of view.

2.3 Dispatch Risk

Based on the Grid Impact Study (GIS) carried out by System Planning Department of NEA, it has been observed that there would be some problem to evacuate power with existing transmission infrastructure. Thus it was decided that LDC would direct the projects connected to the national grid as to when and how much capacity to offtake by NEA. PPAs signed on the basis of GIS and Grid Connection Agreement, an agreement signed between grid owner and developer prior to PPA, after 20th Shrawan, 2070 have incorporated the Take-and-Pay provision. Under Take-and-Pay PPAs, LDC holds the right to take or not take energy generated from hydropower projects into the system. In addition, penalty is not to be paid by NEA even when LDC does instruct the developer not to dispatch energy in case of Take-and-pay PPAs. However, to boost up power sector, based on Energy Crisis Mitigation Action Plan, 2072, NEA's 746th board meeting decided to convert Take-and-Pay PPAs into Take-or-Pay PPAs. Under this decision, 42 PPAs corresponding to Take-and-Pay capacity of 778.42 MW were converted into Take-or-Pay PPAs and NEA continued signing PPAs on Take-or-Pay basis until the total capacity of ROR projects reached 3000 MW. The same Board decision also paved the way to sign Take-or-Pay PPAs for PRoR projects up to the capacity of 2000 MW. Further, White Paper, 2075 that was recently issued by Ministry of Energy, Water Resources and Irrigation has made a provision to sign PPAs with Take-or-Pay provision based on energy mix composition mentioned in White Paper till the hydropower capacity reaches 15,000 MW in next 10 years.

2.4 Force Majeure

In the event of Force Majeure such as earthquake, flood, landslide, strike, protest, etc., project performance is affected which leads to cost and time variation to a project under construction. A bankable PPA should address force majeure events as well. As per the PPAs in practice in Nepalese context, certain force majeure events, as defined in PPA, are compensated with extension of required commercial operation date in case of projects under construction and extension of PPA tenure in case of projects in operation phase.

2.5 Posted Rate

PPA tariff has direct impact on the revenue generation of a power selling entity. For a bankable PPA, this rate should be enough to cover the operating cost of the company, to repay debt taken on time and to provide a reasonable Return on Equity (ROE) to the shareholders. In Nepalese power market, for ROR hydropower projects up to 100 MW, PPA tariff is fixed ,i.e., NRs. 4.8 per kWh during wet season and NRs. 8.4 per kWh during dry season at simple escalation of 3% for 8 years. The tariff for projects of installed capacity 100 MW and above for ROR Hydropower Projects are open for negotiations based on ROE such that ROE higher than 17% leads to the reduction in the project tariff. The tariffs for PRoR and Storage projects, too, have been decided by NEA, i.e., for PRoR projects, dry season tariff (NRs./kWh) is 8.5, 8.8, 9.4, 10.55 for peaking hour of 1 to less than 2 hours, 2 to less than 3 hours, 3 to less than 4 hours and 4 to 6 hours respectively and for wet season, tariff is NRs. 4.8 per kWh. Likewise, for Storage projects, NRs. 12.40 per kWh during dry season and NRs. 7.10 per kWh during wet season. If the wet season energy from a Storage project is more than 50% of annual energy, the wet season tariff will be lowered by the same incremental percentage. However, it is wise to fix tariffs on cost-plus basis and the issue is expected to be sorted out when the Electricity Regulatory Commission will start to function soon. If the tariffs are not attractive, investment in the project cannot be encouraged.

2.6 Foreign Currency Exchange Risk

Electricity Acts of Nepal allows Foreign Direct Investment (FDI) in hydropower sector. As of now, 7 PPAs have been signed between NEA and developers with the condition of payment in US Dollar. Of course, apart from above listed issues, we further need to think about Foreign Currency Exchange Risk in order to encourage FDI in hydropower sector of Nepal. NEA has bitter experiences of Dollar-denominated PPAs in the past. To overcome huge losses incurred to NEA due to lack of proper analysis in the past, various studies were carried out and, as its result, detailed guidelines on Foreign currency-denominated PPAs were approved by NEA. Based on the same guidelines, on 28th January, 2018, PPA was signed for Upper Trishuli – 1 Hydropower Project (216 MW). This PPA has even been regarded as a template for foreign currency PPAs for future reference. Apart from these considerations, investors also intend to have Project Development Agreement (PDA) between the Government and developer to minimize various risks.

3. Conclusion

NEA, being a single offtaker in the country, has so far signed 258 power purchase agreements equivalent to 4,554.325 MW in total with various developers. Most of those projects have already concluded Financial Closure with various financing institutions. Some of the projects have been able to draw FDI as well. However, in order to exploit the hydropower sector completely, more number of developers and investors should be attracted. To do so, it is necessary to create investment-friendly environment. Therefore, it is important to be more careful on above discussed points to make PPAs bankable. Both the Government and NEA should equally pay attention in this regard. Only signing PPA is not enough. If bankability issue is not addressed through PPA, actual development works of hydropower projects will be hindered and it will be difficult to attain the plan of Government to generate 15,000 MW energy in 10 years.

Operational Issues of IPPs Hydropower Project

Sangita Giri
Electrical Engineer, Power Trade Department, NEA

1. Background:

So far there are 72 power projects in operation as developed by Independent Power Producers (IPPs) with total installed capacity of 511MW but due to different operational issues during their operation they are unable to produce energy as it is mentioned in agreement. The share of generation may differ from the share of installed power capacity. Non-availability of capacity may be due to maintenance, unplanned outages and long or short term climatic conditions.

Because of different policies favorable for hydropower generation, many IPPs are in field of power generation but we are not able to harness as much power as we can. One of factors responsible for lower generation efficiency compare to installed capacity of pant is poor operational plant factor, so we need to ascertain factors responsible for poor operational plant factor.

2. Plant factors of IPP's Projects

Within the scope of the article the plant factors (PF) on monthly basis are considered as follows:

1.1 Design-based Plant Factor:

This plant factor is based on the contract energy which is finalized in the energy table incorporated in the Power Purchase Agreement (PPA).

$$\text{Design-based Plant Factor} = \frac{\text{Monthly Contract Energy (kWh)}}{\text{Installed Capacity (kW)} * 30 * 24}$$

2.2 Operational Plant Factor

This plant factor is based on the actual energy delivered by the project to NEA's system

$$\text{Operational plant factor} = \frac{\text{Monthly Delivered Energy (kwh)}}{\text{Installed Capacity kW} * 30 * 24}$$

The above formula relies on the assumption that a plant is operated for 24 hours and 30 days also the installed capacity of plant refers to PPA contract capacity.

It is depicted in the graphical representations below:

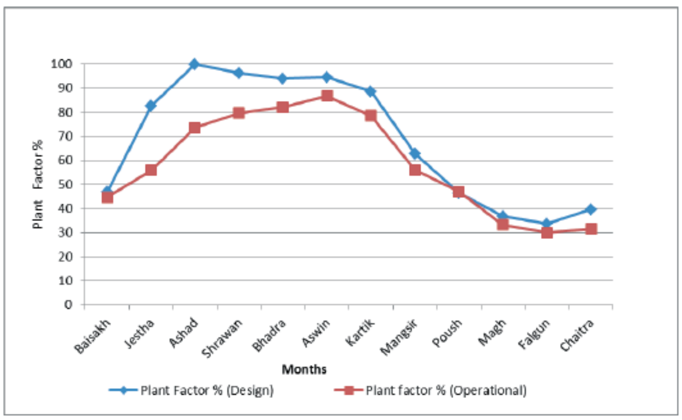


Fig.i Plant Factor Analysis of IPPs' Plants in operation

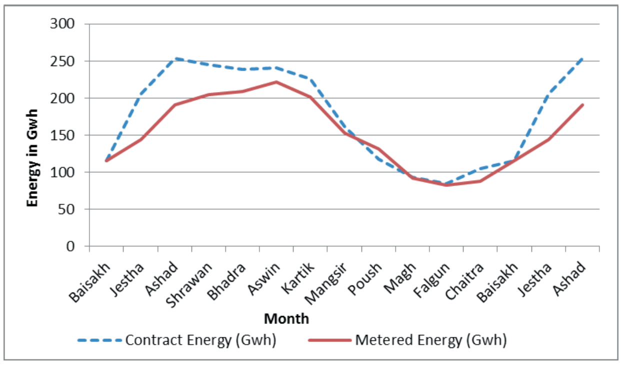


Fig.ii. Energy Generation Analysis of IPPs' Plants in operation

After plotting data of average design-based and operational plant factor of all 72 projects in operation from the private sectors on monthly basis from 2074 Baisakh to 2074 Chaitra , it can be observed that both operational and design-based plant factors for wet season month (from Baisakh to Mangsir) are high. However, operational plant factor is poorer than design plant in wet months (Baisakh to Mangsir), whereas for dry season months (from Poush to Chaitra) both plant factors are very low and very narrowly different from each other as shown in above graphs fig.i.

3. Reasons behind Poor Operational Plant Factor

Factors responsible for poor operational plant factors are as follows:

3.1 Inappropriate hydrological calculation and energy finalization:

Due to lack of poor feasibility analysis on hydrology of specific projects, many developers are unable to meet the monthly discharge mentioned in the energy table. When the energy delivered cannot meet 80% of contract energy or availability declaration (AD), whichever is lower, they have to pay hydrological short supply penalty.

3.2 Line outage and power evacuation problem:

Due to lack of sufficient transmission infrastructure and lack of (N-1) criteria in its design, power evacuation issue is very challenging in Nepal. Tripping in one section will create cascade outage of large part of Integrated Nepalese power System (INPS). Also, new transmission lines are not being ready on time. That's why we are compelled to transfer power through existing transmission line network causing it overloaded. Existing transmission network in many cases may be at lower voltage and power evacuation may have to cover a long distance which increases technical losses of system. It ultimately reduces the energy that can be delivered at a delivery point.

3.3 System shutdown (Maintenance Issues of IPP)

Many IPPs do not have stand by operation and maintenance team. As its result, if any of the equipment fails to operate at any time during operation, it will be time consuming to restore the system. Many IPPs are procuring electro-mechanical equipment from foreign manufacturers about which local repair and maintenance team are not adequately familiar. It ultimately leads to the requirement of hiring experts for its maintenance from the same countries where the equipment is manufactured. It will need long shutdown period for the plants lowering operational plant factor.

3.4 Sedimentation

Dams also impede the natural flow of sediment in rivers. This sediment built up in the reservoir depletes the storage volume, thereby significantly reducing water resource available for generation. There are many examples which turn out our Storage/Peaking RoR (PRoR) projects to Run-off-River (RoR) projects due to lack of proper timely sedimentation flushing mechanism. Maintenance related to silting is expensive and since dams are usually located at difficult geographical area, this creates hindrance to perform the flushing ultimately reducing operational plant factor. It is applicable not only for storage and PRoR projects but also for RoR projects in which water flow in canal is highly affected by the volume of sediments deposited in it.

4. Review of PPA provisions to Address Operational Issues:

NEA is striving to construct all transmission networks on time but due to different problems like clearance of Right of Way, completion time of project is being extended due to which many of the transmission projects are facing problems to evacuate power. In such cases, projects may evacuate power from contingency plans (alternative short term plan) for which both NEA and the developer do not need to pay penalty.

As per the provisions of PPA, following practices are employed to relieve the developers from hydrological short supply penalty

4.1 Availability Declaration

There is PPA provision of submitting Availability Declaration at least 30 days before the start of a contract month. Under this provision, the IPPs have to declare energy not below 60% in wet months and 90% in dry months out of the total monthly contract energy. Also, they can amend monthly AD for one time and the amended AD should be submitted 7 days before the start of the contract month. The AD should be verified by dispatchers before submission. They can get payment for excess energy in case they generate energy more than contract energy but excess energy should be dispatched by local dispatcher while submitting AD of more energy than contract energy.

Also, NEA has amended PPA with regard to hydrology penalty for IPPs projects of capacity up to 10 MW according to which they can declare energy up to 50% of contract energy for both dry and wet months.

In such cases, there will be less chances of short supply penalty clause being attracted. However, due to not fulfilling the required criteria by many developers while submitting AD, the ADs are considered invalid.

4.2 NEA Forced Outage

There are many cases where projects are unable to evacuate power due to tripping of NEA's transmission line. As its consequence, they are unable to meet contract energy. In such cases, they have to keep record of NEA forced outages by verifying them to local dispatcher so that the energy unavailable due to the NEA forced outage could be added to their metered energy so as to meet80% of contract energy or availability declaration (AD), whichever is lower.

4.3 Scheduled Outage

Every Electromechanical equipment needs periodic maintenance to protect them from uncertain emergency shutdown. For which there is provision in PPA to provide project for maintenance, the required scheduled outage plan for given fiscal year have to be submitted to NEA and it will be finalized by coordinating committee before start of the fiscal year by taking consent of the load dispatcher center(LDC). Generally maintenance is carried out in wet season to the extent possible due to energy shortage in dry season Also, difference between design-based plant factor and operational plant factor for wet season is high since most of scheduled maintenance works of IPPs projects are carried out in this period. Due to scheduled maintenance of plant, if they are unable to supply 80%of contract energy or availability declaration (AD), whichever is lower, such energy unavailable due to scheduled outage could be added to metered energy to relieve the developers from short supply penalty.

4.4 Emergency Shutdown:

If there is emergency shutdown of plant during operation, company should inform NEA about this within 24hours from the start of shutdown. Then NEA will give maintenance time if there is valid reason for shutdown and after completion of maintenance, they will have to start plant by coordinating with local dispatcher. If developers are unable to supply 80% of contract energy or availability declaration (AD), whichever is lower, such energy unavailable due to emergency shutdown could be added to metered energy to relieve them from short supply penalty

5.Measures to be taken by IPP's

In context of Nepal, many developers are under financial burden because of not being able to pay the debt within payback period of project. In many cases they are paying high amount oflate project commissioning penalty and short supply penalty keeping this in view there should be focus on some of following points from developers prospective:

5.1 Since hydrology is the main basis of energy estimation, accurate and reliable hydrological data are essential for it. Most of the rivers in Nepal are ungauged and if projects are to be built on these rivers, they are required to correlate hydrometric data of the concerned river with gauged river of similar catchment, These methods rarely give reliable hydro-metric data. In order to reduce effect of inconsistent and unreliable data on project, the energy estimation of a project, detailed hydrological analysis is essential so that there would be less chance for hydrology short supply penalty to projects once they are commissioned. In addition they need to have detailed geographical/ geological study of projects to minimize the problems caused due to natural calamities.

5.2 Developers should strive to complete project on time, if commercial operation date (COD) is not within required commercial operation date (RCOD)of a project, there will be penalty for delay in completion of project. It will ultimately extend payback period of the project.

6. Conclusion:

Comparing generation pattern in dry and wet seasons, it can be stated that there is large variation in energy generation pattern between wet and dry season months. Only about 30% of energy generated in wet season months is available during dry season month. Ultimately it creates compulsion to purchase power from India so as to fulfill both power and energy during dry season. That is why we should strive to make month wise energy generation curve flat in level of maximum energy generation as far as possible for which we should focus on construction of RoR projects with design discharge based on high Probability of Exceedance (PoE) like Q80 or even more. In addition, we should focus on construction of PRoR and Storage plants.

Further, hydropower developers need to pay proper attention for the enhancement of their operational plant factors and PPA provisions are to be taken care of so that the risks of short supply penalty could be reduced to the extent possible.

Hydrological Uncertainties in Hydropower Projects

Sadikshya Maskey
Civil Engineer, Power Trade Department, NEA

Background

Water is one of the most imperative natural resources without which existence of humankind is doubtful. We need water not only to run our daily lives but also to meet the need of modern technology. And although plentiful it is not always in the right place at the right time or of the right quality.

When it comes to defining hydrology and hydropower, the supremacy of water on Earth cannot be overlooked. The word hydrology itself defines its meaning,i.e., the study of water and its movement within the Earth's atmosphere. It has evolved as a science to try and understand the intricate water systems of the Earth, to study and predict how water will behave under different circumstances as it moves within the planet Earth. Similarly, the term hydropower clearly means the power or energy that is generated from the moving water. Humans have been taking advantages of water for centuries, from running the mills during ancient Greeks to gigantic largest hydropower planttill date, "Three Gorges Dam" in China. Hydro plant has been creating massive amount of energy and contributes about 16% of global electricity generation. Harnessing the power of water is the cheapest form of energy, but environmental and other concerns cast doubts on its worth. Developed and experienced countries in the field of hydropower use the modern and finest technologies to minimize the challenges hydropower can bring. Nevertheless, for the country like ours where the era of hydropower has just begun, it is very much important for every single hydropower project to undergo hydrological analysis from base level to eradicate the problems in sustainability of hydropower projects.

Data Assessment: Foundation Of Energy Estimation

Water resources cannot be managed unless we know where they are, in what quantity and quality, and how variable they are likely to be in the foreseeable future. Nepal is blessed with around 6000 rivers and rivulets with enormous hydropower potential though it is difficult to harness available potential. One of the stumbling blocks in a sound planning of hydropower projects could be the availability of stream-flow discharge data. In the countries like ours where we suffer from scarce of data,extrapolating from local measurements to get a regional picture is indispensable for today's need. Also, available data are not only inconsistent but also not plenty for planning as water resources project planning requires about 30 years of discharge data and most of the hydropower sites are remotely located and ungauged.

Department of Hydrology and Meteorology, under the Ministry of Energy, Water Resources and Irrigation, GoN, which is responsible for the data acquisition, processing and validation of measurements made in field,is responsible to make hydrometric data easily accessible. In addition, measured data needs to be pooled, quality controlled and archived. Tilldate, it has 16 synoptic stations and around 500 hydrological and meteorological stations (DHM, 2018), out of which many are not functional. Figure below shows the major rivers of country and existing hydrological stations. Traditional method of recordings has led to unreliable and inconsistent data, which sooner or later will affect the outcome of planned projects. Many stations havedata recorded only till the year 2006 A.D. In this long gap of 12 years, trend of stream flow may have changed remarkably. Moreover, the energy estimated for hydropower projects considering these stream flow data will obviously be impractical and questionable. Similarly, urgency of snow hydrology is also felt as maximum rivers are fed by thawing snow. Good forecast of snowmelt runoff during dry season has now become obligatory as dry energy issue is one of the prime concerns for both NEA and Independent Power Producers.

Mechanisms of Energy Estimation

Each hydropower project requires an ample availability of stream flow data. However, most of the hydropower projects in Nepal especially small hydropower projects are built on ungauged river. Unfortunately flow estimation methods being practiced currently employ a lot of assumptions which lead to uncertainty. In the context of our country, some of the common approaches of flow estimation are:

- Catchment Area Correlation Method
- WCS-DHM (Hydest) Method
- Medium hydropower Study Project (MHSP) Method
- Medium Irrigation Project Method (MIP)
- Regional –Regression Method

However, none of these methods can estimate the flow accurately than the stream flow data recorded on the corresponding rivers.

Probability Of Exceedence (POE) And Flow Duration Curve (FDC)

An important question often asked is: What percentage of time does flow exceed a given value?' For anyone who

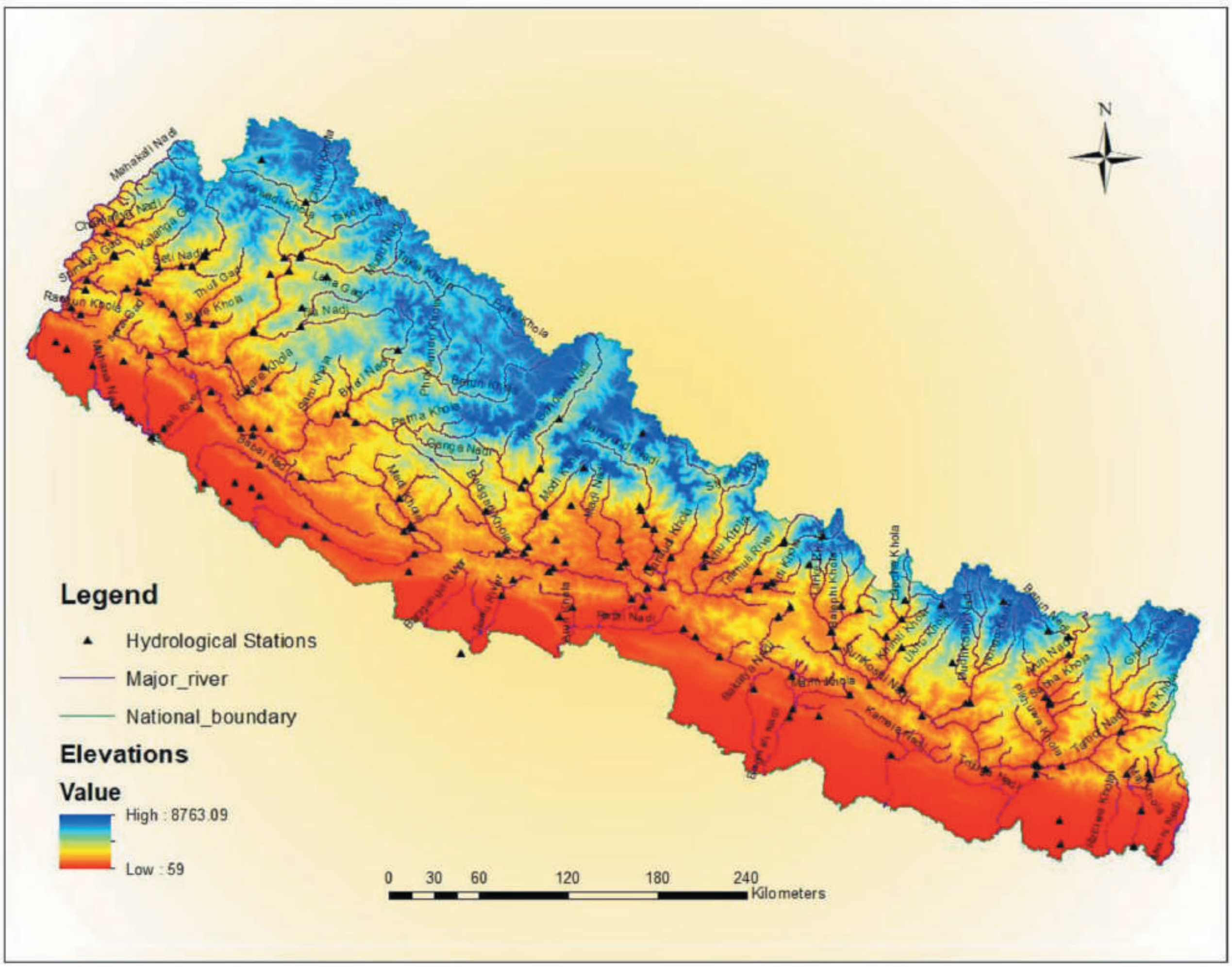


Fig. i: Physiographic regions of Nepal showing major rivers and hydrological stations.

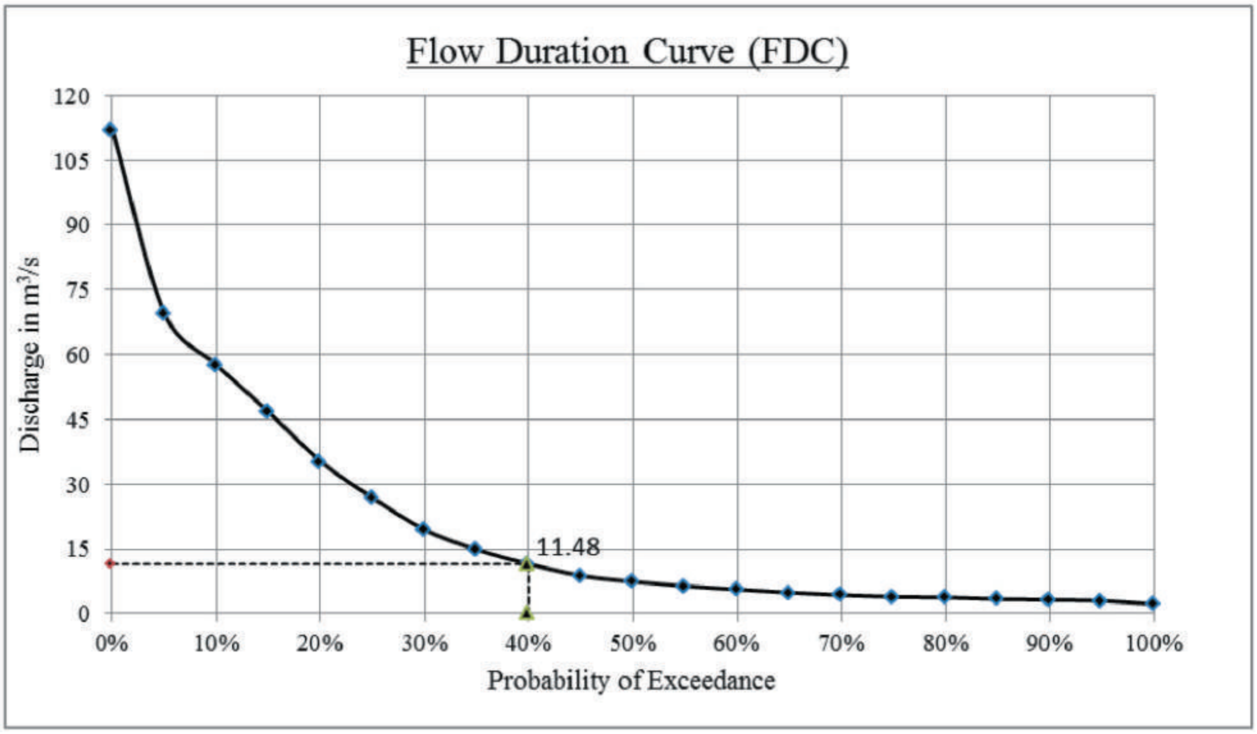


Fig. ii. Flow duration curve.

is into hydropower field, it is of major concern to answer this question to determine the percentage of time when the flow is too low to meet dry energy. Identification of capacity of hydropower plant, which allows for the optimal utilization of available water resources and it is also a challenging task, mainly because of the inherent temporal variation of river flows. Flow rate is often considered as 'Q' and the exceedence value as a subscript number. The proportion of time at which any given flow is exceeded can be determined by generating flow duration curve. In order to explore the feasibility of hydropower, it is necessary to define the variability of flow available in the streams. This is normally done by direct analysis of stream flow data or by applying some sort of inferential techniques from gauged to ungauged streams. Of course, the most reliable means is to use the actual stream flow data measured at the point of interest. The problem in Nepal, as in most locations, is that stream flow information is not available for all possible sites. The flow duration curve provides us with a means of representing the variability of flow at a proposed hydropower site in a concise graphical fashion. Flow duration curves have proven to be useful in evaluation of surface water resources for hydropower design and other studies where it is desirable to define the variability of the flows in streams.Graph below indicates the discharge of a river corresponding to 40% of probability of exceedence.

NEA has a trend of designing hydropower projects at Q40 design discharge to ensure the full capacity of a power plant for at least five months. ROR projects, designed at Q40 have been easily operating their plants for around five months as the water level rises in the rivers during wet season. Situation other than adopting Q40 is briefly discussed below.

Considering the Energy kill situation in the case of hydro plants with design discharge of Q40 or greater than Q40,Department of Electricity Development (DoED, 2018) has recently provisioned in the guidelines that the hydropower plants that applying for license would need to be designed at basis of Q45. It means that the plant has to run under full capacity for around 5.4 months a year. If the power plants need to be operated for a longer period in rated capacity, the IPP's would have to lower the capacity of plant.

'Energy Spill' situationduring monsoon may occur in the case of projects designed for probability of exceedence less than 40%. As per present PPA policy, NEA does not sign the Power Purchase Agreement with Independent Power Producer, for the projects with design discharge less than Q40 fearing the energy spill during wet season.

Environmental Releases

Water Resources Act, 1992 states that if a person or corporate body wants to conduct survey or utilize water resources they should carry out environmental study along with the application. The Environment Protection

Rules, 1997 based on Environment Protection Act has made it mandatory for projects above 50 MW to conduct Environmental impact Assessment (EIA) and for projects below 50MW to submit Initial Environmental Examination (IEE) report. Further, Hydropower Development Policy 2001 has specifically mentioned that the "Downstream release shall be either 10% of minimum mean discharge or quantum identified in EIA whichever is higher (G.DiBaldassare, 2009).

Current downstream release practices rarely consider project-specific scenarios and do not include aquatic habitat condition as well as how hydraulic variables of river change as flow regime changes. This indicates that the practice we have been using holds no methodical approach but only a statistical representation of natural flow regime.

Outage and Losses

A short term or a long term loss of electric power supplied to a particular area is power outage. There can be unforeseen causes of power failures in electricity network. Main outages that cannot be shunnedand are considered in PPA are forced outage and scheduled or maintenance outage. Losses, which are incorporated on energy table for the calculation of contract energy, represent the transmission loss. Losses from power generation point to a delivery point of NEA are incorporated in Energy Table in the form of certain percentage of contract energy.

- The combined outage and losses incorporated in the Energy Table are as follows:
- 4 % of the total annual contract energy for the voltage level 132kV of connecting transmission line.
- 5% of the total annual contract energy for voltage level 33kV of connecting transmission line.
- Figure below shows the procedure of energy estimation from base level.

Conclusion

There is no any tailor-made solution to build any hydro power projects. Every individual hydropower projects vary from one other in their salient features. Every projects need to have reliable and consistent hydrometric data collection and analysis for the sake of correct energy estimation. Projects need to install their own gauging stations in case of ungaged river. Because assumed and uncertain adopted data will be detrimental to energy assessment. To preserve poise between development and environmental stability, better study on environmental

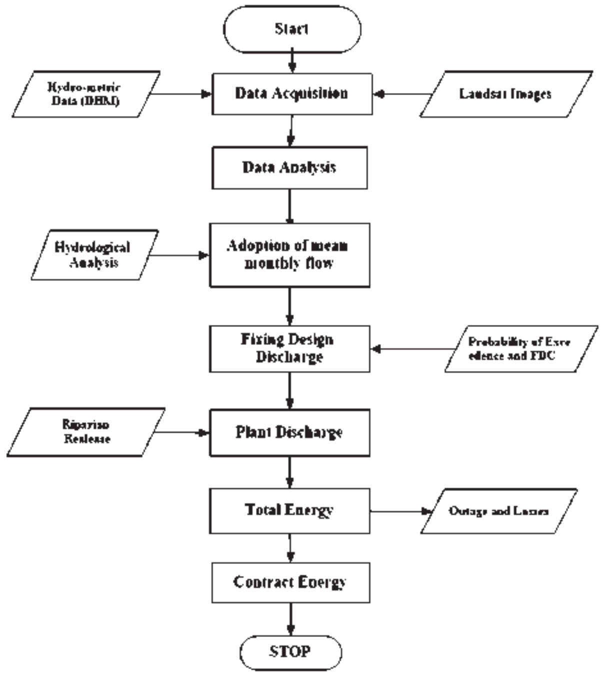


Fig.iii Flowchart for procedures of energy estimation.

releases shall have to be conducted. Other than this, the impact of sedimentation on a particular project shall be studied. From depleting the storage volume for storage projects to decreasing the life of electromechanical equipment in RoR and Peaking-RoR type projects, it has an adverse effect that cannot be ignored. Looking at the scenario of projects in operation, rarely we can find any project that delivers the accurate energy as contracted in PPA. This is because the approaches and methodologies we adopt for the energy estimation are mostly based on assumptions.

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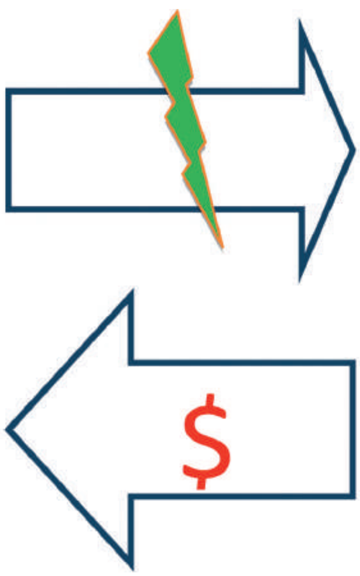
Role of Utility Scale Solar PV in Nepal from Energy Security Point of View

Ram Prasad Dhital, Executive Director, AEPC
Jiwan Kumar Mallik, Solar Power Expert

Nepal was the second country to commission hydropower plant in Asia (source: Nepal Energy Forum). It was back in 1911 when the 500 kW Pharping Hydro started generating electricity. After over a century, however, installed capacity has barely reached 1000MW. The Water and Energy Commission Secretariat (WECS) report from 2017 forecasted demand of electricity to reach 30,000 MW by 2040 to maintain economic growth rate at 7.2 percent. This raises a serious question on whether the current trend of hydropower development can meet the future requirement. The annual report of Nepal Electricity Authority 2017 states that the financial closure of 102 projects with a total capacity of nearly 20,000MW and Power Purchase Agreement (PPA) of around 9,000 MW is complete. The report also says that around 1,500MW worth of projects are under construction. These figures and trends in hydropower development expose the real challenge that Nepal will face in order to balance future supplies and demands.

The popular phrase, “don’t put all your eggs in one basket", is highly relevant in the context of electricity generation which should be brought into to practice urgently as Nepal relies heavily on only one type of generation. Diversification



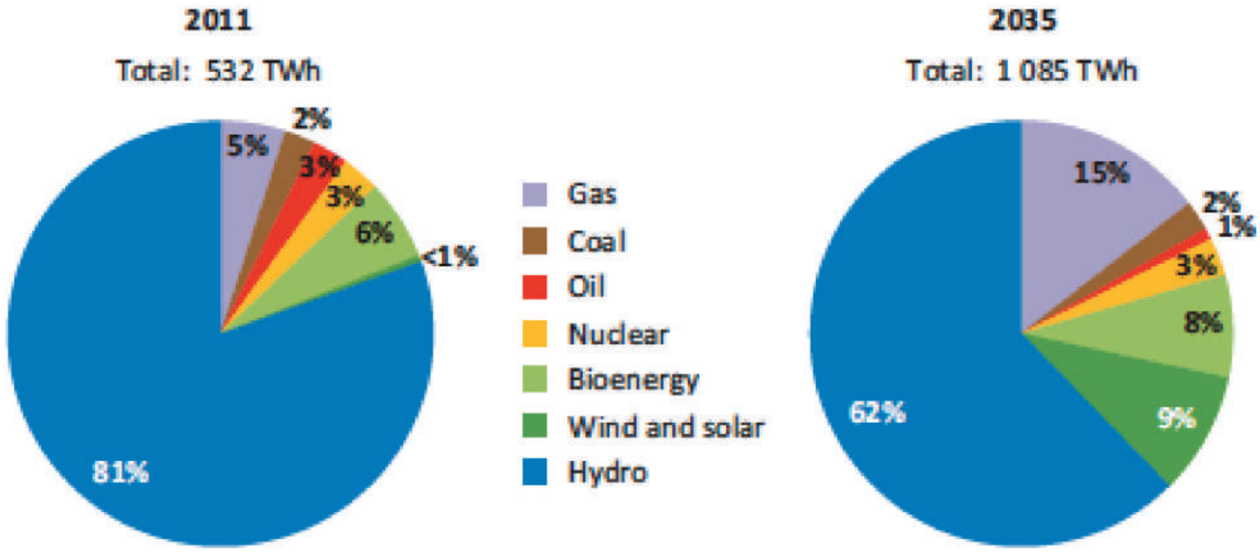


Figure 1:Brazil Power Generation Mix Strategy

of generation mix is essential in the country as this nation is highly vulnerable to climate change. Many studies and researches have reported the decreasing trend of river flow. Recently, an existing turbine was replaced by a lower capacity turbine to counter the decreased water flow in one of the Micro Hydropower plant supported by AEPC. Further, civil structure comprises of nearly 60 percent of the overall hydropower project, which can make the power system more vulnerable to natural calamities such as earthquake and flash flood. The earthquake of 2015 and flash flood in Bhotekoshi in 2014 are few of the examples that shows how vulnerable hydropower sector is in the country. Thus, relying only on one source of power generation may not be the wisest option. While, Solar PV plants have less than 5 percent of civil structures, making these systems less vulnerable to natural disaster.

Similar to Nepal, Brazil, which is also amongst the richest in hydro resources, made decision to scale up Wind and Solar generation source. In 2011, the constitutes of wind and solar in Brazil was less than 1 percent. Recently, they have targeted to achieve the share of wind and solar to 9 percent by 2035. This shows how hydro dominated nations are also switching towards increasing generation mix and protecting its energy security through available wind and solar resources.

The daily load curve in Nepal shows a sharp evening peak, mostly due to residential consumption when commercial and industrial loads are minimal. The International Energy Agency (IEA)on 2015 produced sector wise average consumption of electricity which showed that residential sector consumes nearly 27 percent. In Nepal, residential consumption is about 45 percent(refer to Figure 2 below). This is because in most of the developed countries, the commercial and industrial consumption is more than residential load and if Nepal achieves similar economic growth, the future consumption will also be dominated by commercial and industrial sectors. Under this condition, the day time demand will closely match to evening

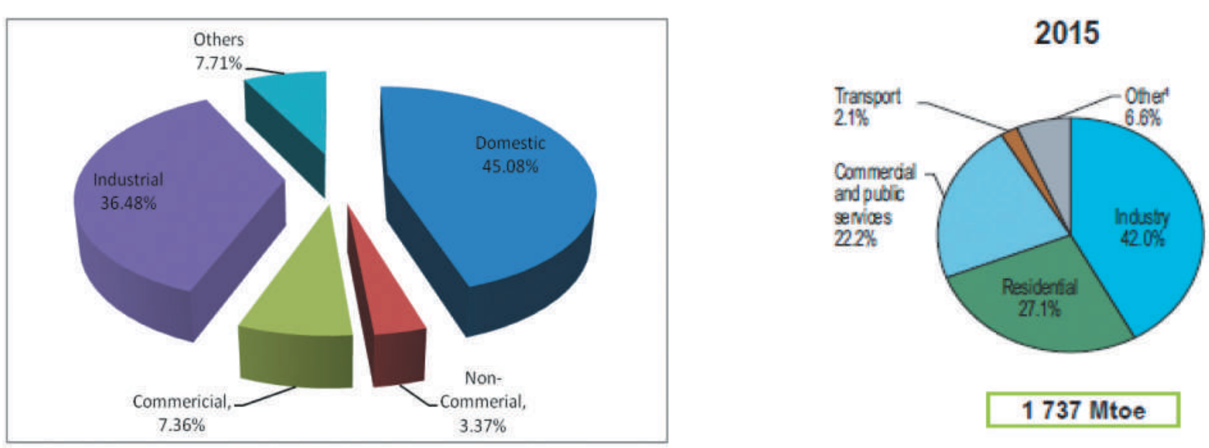


Figure 2: Sectoral comparison of Electricity; left one is for Nepal (WECS data) and right one is World Average (IEA)

consumption, making the daily load curve similar to that of Thailand whose major economy is tourism has flat load curve. In order to supply power to this increasing daytime, Solar PV will be the best amongst the other generation sources available in Nepal. A multiple use of land can get benefited from the concept of "Agro-PV" (farming the vegetables underneath of solar PV array).

Intermittency Effect of Solar

The common perception in Nepal is that the solar is limited to general lighting for households and small institutions such as schools and health posts. Whenever we think on upscaling the system and connecting it to the grid, concerns over the intermittency due to solar are quickly raised and are directly linked to future frequency and voltage instability. In a recent global forum in Philippines, the 2018 Asia Clean Energy Forum, over 1300 professionals discussed on the intermittency effect of Solar in the grid and recommended (i) determination of solar penetration is country specific Grid Impact Study and this study shall have to be dynamic, one time study can't predict for long time, (ii) the penetration up to 15-20% of total installed capacity will not raise instability in the grid, (iii) Frequency Linked Deviation Mechanism, Dynamic Load Balancing, Load Curtailment , Storage could be solution for higher level of penetration to maintain the grid stability. This forum also concluded that effect of Solar penetration in the grid should be based also on practice and observation from "learning by doing". In Nepal, several initiatives and studies were conducted on grid connected solar but not a single implementation of utility scale solar has been seen to date. Finally, it is better to be specific, demonstrate, learn and grow rather than sticking only to ideas.

Recommendation for Accelerated Growth of Solar PV in Nepal

- National Policy - The revision of Electricity Act is underway, this policy should clearly define the need of Power Generation mix from the prospective Energy Security. For example, 15% of total generation should be from Solar PV.
- Viability Gap Funding (VGF)- NEA in coordination of ADB has recently announced Request for Proposal (RfP) for development of utility scale Solar PV. Though, the gestation period of Solar is shorter than hydro, the VGF incentive until June 2022 may not be make financial viable project at base PPA rate of NRs. 6.6/kWhr. It is suspected that some of the infeasible low bid proposals may come from ill intention to distort solar market in Nepal rather than development of project in-time.
- Determination of separate PPA rate for utility scale Solar PV- Recent Directive on Grid connected Alternative Energy by Ministry of Energy Water Resource and Irrigation has declared PPA rate of NRs. 7.3/kWhr. This PPA rate is derived just from a posted PPA rate of NRs. 4.8/kWhr and NRs. 8.4/kWhr in wet and dry season months respectively , for a hydropower project including 3% of escalation for 8 times for 25 years project period. The PPA rate for Solar should be separately defined in a more scientific way considering some other aspects like project size, land availability, power evacuation options etc.
- Establish Solar Parks & Solar Cities in each of 7 Provinces for demonstration effect.
- Efficient Market Based Financial Mechanism like VGF, Carbon Development Mechanism (CDM), Accelerated Depreciation etc.
- Establish R&D facilities at academic, research institutions for Solar PV
- International Partnerships /Collaboration
- HR Developments for Solar Revolution

Conclusion

Solar should complement hydro generation in Nepal. The deployment of grid connected solar won't hinder hydro development at all . Rather, Hydro can still be main stream generation source followed by utility scale solar and roof top solar. Around the world, utilities are rapidly moving from Analogue to Digital, Fossil to Renewable and Centralized to Distributed System.

It's time to think on similar way rather than hydro-centric thought only. Realizing these facts, in the recent White Paper published in Baisakh 2075, the importance of distributed generation and utility scale solar have been proposed. Initiation of installation of solar PV of huge capacity in Province no. 2,implementation of grid connected rooftop solar PV and grid connected solar PV of capacity ranges from 100-500kW in rural municipalities are some of the ambition plans to diversify our generation mix.

We should re-think electricity sector from the prospective of the national Energy Security. A calculation shows that 135 MWp Utility Scale Solar would be required to replace the day time import from India. It's high time to join hands together to realize the governments priority in diversifying energy generation options.

A Brief Introduction of Infrastructure Asset Management and its importance in Operation of Hydropower Projects

Sushmit Sharma Bhattarai
Engineer, BE (Civil), MSc. (ICME)
Manager, Kasuwakhola Hydropower Co. Ltd.

Abstract

Large infrastructures such as roads, rivers, dams, harbours, airports, waterworks, and railroads provide a platform for economic and social development and meet essential needs of the community. It has become essential to ensure that these infrastructures will continue to provide sustainable and economical service by intensive maintenance and modernization or life extension of ageing assets. A new concept of asset management disciplines and procedures have been materialised in the developed nations for sustainability of infrastructures including hydropower projects. Hydropower has been recognised as the key source of commercial energy for electricity generation in Nepal that can drive the nation into development. A country should analyse the importance of infrastructure asset management and follow the principles to overcome variety of challenges such as ageing, deterioration, underfunding, disruptive events and inherent risks that disrupted continued operation of hydropower projects. The focus of this article is to introduce infrastructure asset management and aware its beneficiary in operation of hydropower projects. This article provides a basis to undertake infrastructure asset management activities including development of an asset strategy.

Infrastructure Asset Management

Definition

Woodhouse (2001) believe asset management is initially practised in the highly structured or regulated institutions such as armed forces, airlines and nuclear sectors, which later emerged in power, water, housing and other areas (Woodhouse, 2001). On the other hand, Brown and Humphrey (2005) claim the term 'asset management' first arose in the finance sector to balance the risk and return. Later same approaches, techniques and tools have been developed to suit asset management practices in other industries, such as electricity, gas and water.

Alegre (2007) suggests 'Asset Management is a multidimensional approach that may be defined as the business strategy and the corresponding planning and systematic and coordinated activities and practices through which an organisation optimally manages its assets, and their associated performance, risks and expenditures over their lifecycle'. The globally reconised asset management standards IAM/BSI (2008) superseeded by ISO 55000(2014) defines asset management as 'systematic and coordinated activities and practices through which an organization optimally manages its assets, and their associated performance, risks and expenditures over their lifecycle for the purpose of achieving its organizational strategic plan'.

In summary, the primary objective of infrastructure asset management is to resolve the demand for, and supply of, physical asset base and associated support services essential for the delivery of its core services.

Principles of Asset Management

Asset management has become an overarching tool accepted by different organisations. ISO 55000:2014 identified seven principles of asset management and recommended by IAM as well are:

- Holistic;
- Systematic;
- Systemic;
- Risk-based;
- Optimal;
- Sustainable;
- Integrated.

Woodhouse (2011) suggested that these general principles apply to all asset management activities. He added these are good indicators of the likely performance, robustness, flexibility, and sustainability of the company's core functions. These principles give general idea of asset management to be applied and developed in any developing nation.

Davies (2016) emphasised fundamental principle of asset management is "Line of Sight" which means:

- An approach within an organisation that looks to line up the work that is done directly on assets with the objectives of that organisation;
- A discipline which recognises, accommodates and aligns the risk of owning a particular asset with the goals of the organisation that operates the asset.

Asset Management Framework

In its most general sense, 'asset management is a business approach to align the management of asset-related spending to corporate goals', and 'the payoff is a set of spending decisions capable of delivering the greatest stakeholder value from the investment dollars available' (Brown, 2004). There is different asset management framework suggested by various organisation and standards such as BSI PAS 55 (BSI, 2008); TAM (NSWT, 2006); Key Areas of AM strategy (Edwards, 2010); AM models (Too, 2006&2010); and AAMCOG (2011). The main purpose of each framework is to follow the asset management principle and to create value for the organisation to meet stakeholders' requirements and expectations. GFMAM (2014), IAM (2015) and Davis (2016) emphasisedasset management framework should include seven basic benchmarks shown in Table 2-1 below.

S.N	Requirements of Asset Management	Criteria of the benchmarks
1.	Asset Management Strategy and Planning	Asset Management Policy Asset Management Strategy Demand Analysis Strategic Planning Asset Management Plans
2.	Asset Management Decision-Making	Capital Investment Decision-Making Operations & Maintenance Decision-Making Life Cycle Cost and Value Optimisation Resourcing Strategy and Optimisation Shutdowns & Outage Strategy and Optimisation Ageing Assets Strategy
3.	Lifecycle Delivery Activities	Technical Standards & Legislation Asset Creation & Acquisition Systems Engineering Maintenance Delivery Reliability Engineering and Root Cause Analysis Asset Operations Resource Management Shutdown/Outage Management Incident Response Asset Rationalisation & Disposal

4.	Asset Knowledge Enablers	Asset Information Strategy Asset Knowledge Standards Asset Information Systems Asset Data & Knowledge
5.	Organisation and People Enablers	Contract & Supplier Management Asset Management Leadership Organisational Structure, Culture, Roles & Responsibilities Competence & Behaviour
6.	Risk & Review	Criticality, Risk Assessment & Management Contingency Planning & Resilience Analysis Sustainable Development Weather & Climate Change Asset & Systems Performance & Health
7.	Monitoring	Asset & System Change Management Management Review, Audit and Assurance Accounting Practices Stakeholder Relations

Table 2-1 Benchmarks of Asset Management Framework (Adapted from IAM, 2015; Davies, 2016)

Above benchmarks is a fundamental concept to apply asset management for any organisation. This literature gives clear idea to the researcher to develop asset management framework for theoperation of hydropower projects in Nepal. From this concept of knowledge, an organisation can efficiently develop asset management paradigm. The detail about the benchmarks is described below clearly.

Asset Management Challenges

Asset management has been the subject of practice and research for decades, there is no common understanding of what asset management is. It is conceptualised as a capability (Wenzler, 2005), process (Amadi-Echendu, 2004) or responsibility (Vanier, 2001). Current systems of managing assets pose several challenges to its implementation. The main difficulties described by Schraven et al. (2011) are alignment between the three decision areas: objective, situation and intervention, with clearly defined objectives serving as a rationale for decisions within the other two areas. Stillman (2015) points out four common challenges on asset management which are:

Data sufficiency

Information systems are tools to support asset management system. If there are lack of sufficient data about the conditions of assets and ages, then it will be difficult to apply proper asset management system.

Inadequate resources

If there are insufficient resources, asset management could not be achieve deffectively. Resources such as finance, spare parts, tools and workforce are key when implementing asset management.

Resistance to change

One of the difficult challenges of an asset management is resistance to change. Most of the organisation practice its old practice of management and do not want to change. Organizations do not believe in sustainable change and progress towards reliability and better performance.

Operational silo

Organizations are structured into maintenance, operations, and engineering with functional heads of departments resulting 'silo thinking'. The result is that budgets are planned and controlled with little consideration for the performance of the whole organisation (Huggett, 2012). This silo thinking always challenges to work in cross-functional teams to take decisions in the best interest of the organisation.

The knowledge about consideration mentioned above will help organisation while following asset management framework for an entirely new country with no knowledge of asset management. The organisation must aware of challenges during technology transfer.

Hydropower Projects in Nepal

Background

Nepal is a land-locked country, which has transited from conflict to peace and challenging for significant development in infrastructure. The water resources of Nepal are regarded as one of the key opportunities for future economic development of the country. Nepal is rich in hydro resources, with one of the highest per capita hydropower potentials in the world (Sangroula, 2006). The climatic and topographic conditions of the country make it favourable to develop hydropower projects.

Hydropower has been used for more than a century in this country, with the starting of 500KW Pharping Hydropower plant in 1911. Similarly, the second hydropower plant (640 KW) was developed at Sundarijal in 1936. Then Morang Hydropower Company in 1939, Sikarbas Hydro plant(677 KW) in 1942 although a landslide destroyed this plant in 1960s. The development of hydropower was institutionalised after the initiation of the development planning process. The First Five-year Plan (1956-61) targeted to add 20 MW of hydropower. However, the goal was unmet. During the Second Three-year Plan (1962-65), some progress was achieved. After a long gap, in 1965, the country expanded hydropower generation with the construction of the Panauti Hydro plant (2400 KW) and the Trishuli Hydro plant (21000 KW) in 1967. A series of hydropower projects then followed (Sharma and Awal, 2013).

Nepal has generated 967.85 MW (NEA Annual Report, 2017) from hydroelectricity so far including NEA, PPP, IPP and foreign investors. Despite more than a century-long history of power generation, the nation could not develop enough hydropower projects. The main reasons behind this are decisions either dominated by the economics of the project or guided by vested preferences of donors as well as politicians ruling the country (Sangroula, 2006).

Challenges Associated with the Hydropower Plants

Nepal has a high potential of development in hydropower, agriculture and tourism sectors. However, Nepal has not fully and efficiently utilised its resources for the development.There are several socio-economic and political challenges in Nepal, which limits the maximisation of energy generation in hydropower plants and could not generate enough potential energy. In the present context of Nepal, the demand for electricity has exceeded the amount of electricity that can be supplied by the government, resulting in frequent power disruption in the country. To supplement the energy shortage, the government is importing electricity from India, producing electricity from fossil fuel for short term preventive measures (Joshi &Shrestha, 2014). Ministry of Energy, Water Resources and Irrigation has formed different High-level taskforces consecutively to develop plans for generating 3,000 MW in 3 years, 5,000 MW in 5 years and 15,000 MW hydropower projects in 10 years (MOEN, 2018). Nonetheless, some populations still suffer from frequent electricity outage while there are ample of hydropower development opportunities.

Also, the developed projects could not generate rated capacity due to the constant breakdown of the project. The reasons behind the continuous breakdown of projects are poor operation and maintenance, high demand and different natural hazards.

Importance of Asset Management in operation of hydropower projects

Different developed countries such as Australia, USA, UK have practised asset management in a hydropower projects. Although they have followed different frameworks as per their nation's requirements, they have followed a fundamental principle of "Line of Sight" i.e. reliable supply of electricity ensuring power generating asset are properly operated, inspected and maintained with minimum cost and risks. To achieve the line of sight, USA has practised Integrated Business Management Model (IBMM) to provide a framework for ongoing asset-based planning and management with 12 business processes contained within four broad areas - Strategic Planning, Asset Planning, Resource Management, and Performance Assessment model which consists of four major areas with twelve business processes. Similarly, Hydro Tasmania, Australia develops frameworksof four main benchmarks including Asset base planning, Business risk identification, Operational Risk Management Programmes, Capital Investment Programme. On the ot her hand, Scottish hydro follows the PAS 55 (currently ISO: 55000) standard. Overall, even though the framework is different, the principle should concentrate on the reliable supply of power with minimum cost and risk.

Nepal lacks sufficient capacity to supply adequate electricity, the country is also facing inevitable problem in maintenance and operation of existing plants due to forced outages, ageing of plants and natural risks hindering the country's economic growth. It has not given the importance of the reconstruction, rehabilitation and post maintenance planning for ageing infrastructure. Continuing deferment of maintenance of assets affects the sustainability of electricity generation. There is a need to explore ways to improve service levels and to consider to what extent these can contribute towards achieving the goal of sustainable electricity supply. This underscores the need for efficient management and maintenance of existing assets in operation of a hydropower project. Considering this, infrastructure asset management for the hydropower projects is important regarding achieving its value for money, risk-based decision, whole life optimisation and long-term sustainability (PAS 55-1, 2008). Aging assets and uncertainty in reliable supply and demand management produce a challenge for the optimal operation and maintenance of the hydropower assets. Asset management can minimise the risks associated with equipment failure, thereby extending the life of equipment and minimising the risk of equipment failure and reduce the occurrence of costly unplanned outages (Reddy, 2016). If properly applied, asset management can assist the operation of hydropower plants with the strategic link between reliable power supply and asset management strategies.

Conclusion

This article helps to acknowledge extensive overview of infrastructure asset management and its principle to apply in physical infrastructures. This article has presented that asset management covers the procurement, operational management, maintenance, rehabilitation and disposal of assets, such that their use is maximised about their service delivery potential and that risks and costs are managed over their entire life of anyasset. Moreover, this chapter details the background of hydropower projects in Nepal, practices of asset management in hydropower by developed countries and importance of asset management in operation of hydro power projects in Nepal. In summary, this articleprovides an acknowledgement to the hydropower developers about tools and techniques of asset management paradigm that can be implemented in hydropower operation considering the principles, a framework with its challenges for a reliable supply of electricity ensuring power generating assets are properly operated, inspected and maintained with minimum cost and risk.

References

More Than 30 references are used for the article .

NEPAL ELECTRICITY AUTHORITY

POWER TRADE DEPARTMENT

IPPs' Hydro Power Projects (Operation) as of FY 2074/75

S.N.	Developer	Projects	Location	Capacity (kW)	PPA Date	Commercial Operation Date
1	Himal Power Ltd.	Khimti Khola	Dolkha	60000	2052.10.01	2057.03.27
2	Bhotekoshi Power Company Ltd.	Bhotekoshi Khola	Sindhupalchowk	45000	2053.04.06	2057.10.11
3	Syange Electricity Company Limited	Syange Khola	Lamjung	183	2058.10.03	2058.10.10
4	National Hydro Power Company Ltd.	Indrawati - III	Sindhupalchowk	7500	2054.09.15	2059.06.21
5	Chilime Hydro Power Company Ltd.	Chilime	Rasuwa	22100	2054.03.11	2060.05.08
6	Butwal Power Company Ltd.	Jhimruk Khola	Pyuthan	12000	2058.03.29	1994
7	Butwal Power Company Ltd.	Andhi Khola	Syangza	9400	2058.03.29	2071.12.22
8	Arun Valley Hydropower Development Co. (P.) Ltd.	Piluwa Khola Small	Sankhuwasabha	3000	2056.10.09	2060.06.01
9	Rairang Hydro Power Development Co. (P) Ltd.	Rairang Khola	Dhading	500	2059.08.27	2061.08.01
10	Sanima Hydropower (Pvt.) Ltd.	Sunkoshi Small	Sindhupalchok	2500	2058.07.28	2061.12.11
11	Alliance Power Nepal Pvt.Ltd.	Chaku Khola	Sindhupalchok	3000	2056.11.03	2062.03.01
12	Khudi Hydropower Ltd.	Khudi Khola	Lamjung	4000	2058.03.04	2063.09.15
13	Unique Hydel Co. Pvt.Ltd.	Baramchi Khola	Sindhupalchowk	4200	2058.12.14	2063.09.27
14	Thoppal Khola Hydro Power Co. Pvt. Ltd.	Thoppal Khola	Dhading	1650	2059.11.23	2064.07.13
15	Gautam Buddha Hydropower (Pvt.) Ltd.	Sisne Khola Small	Palpa	750	2061.04.29	2064.06.01
16	Kathmandu Small Hydropower Systems Pvt. Ltd.	Sali Nadi	Kathmandu	250	2062.04.24	2064.08.01
17	Khoranga Khola Hydropower Dev. Co. Pvt. Ltd.	Pheme Khola	Panchtar	995	2057.12.31	2064.08.05
18	Unified Hydropower (P.) Ltd.	Pati Khola Small	Parbat	996	2062.10.28	2065.10.27
19	Task Hydropower Company (P.) Ltd.	Seti-II	Kaski	979	2063.06.08	2065.11.14
20	Ridi Hydropower Development Co. (P.) Ltd.	Ridi Khola	Gulmi	2400	2063.05.08	2066.07.10
21	Centre for Power Dev. And Services (P.) Ltd.	Upper Hadi Khola	Sindhupalchowk	991	2064.04.07	2066.07.22
22	Gandaki Hydro Power Co. Pvt. Ltd.	Mardi Khola	Kaski	4800	2060.07.07	2066.10.08
23	Himal Dolkha Hydropower Company Ltd.	Mai Khola	Ilam	4500	2063.11.19	2067.10.14
24	Baneswor Hydropower Pvt. Ltd.	Lower Piluwa Small	Sankhuwasabha	990	2064.07.21	2068.04.01
25	Barun Hydropower Development Co. (P.) Ltd.	Hewa Khola	Sankhuwasabha	4455	2061.04.02	2068.04.17
26	Bhagawati Hydropower Development Co. (P.) Ltd.	Bijayapur-1	Kaski	4410	2066.03.30	2069.05.04
27	Kathmandu Upatyaka Khanepani bewasthapan Board	Solar	Lalitpur	680.4	2069.06.12	2069.07.15
28	Nyadi Group (P.) Ltd.	Siuri Khola	Lamjung	4950	2064.04.17	2069.07.30
29	United Modi Hydropwer Pvt. Ltd.	Lower Modi 1	Parbat	10000	2065.10.20	2069.08.10
30	Synergy Power Development (P.) Ltd.	Sipring Khola	Dolkha	9658	2065.10.20	2069.10.03
31	Laughing Buddha Power Nepal (P.) Ltd.	Middle Chaku	Sindhupalchowk	1800	2066.11.03	2069.11.15
32	Aadishakti Power Dev. Company (P.) Ltd.	Tadi Khola (Thaprek)	Nuwakot	5000	2061.12.15	2069.12.14

33	Ankhu Khola Jal Bidhyut Co. (P.) Ltd.	Ankhu Khola - 1	Dhading	8400	2066.02.22	2070.05.05
34	Nepal Hydro Developer Pvt. Ltd.	Charanawati Khola	Dolakha	3520	2067.01.13	2070.02.24
35	Laughing Buddha Power Nepal Pvt. Ltd.	Lower Chaku Khola	Sindhupalchowk	1800	2063.07.02	2070.04.24
36	Bhairabkunda Hydropower Pvt. Ltd.	Bhairab Kunda	Sindhupalchowk	3000	2065.08.02	2071.02.22
37	Radhi Bidyut Company Ltd.	Radhi Khola	Lamjung	4400	2066.10.18	2071.02.31
38	Pashupati Environmental Eng. Power Co. Pvt. Ltd.	Chhote Khola	Gorkha	993	2067.11.09	2071.03.09
39	Mailung Khola Hydro Power Company (P.) Ltd.	Mailung Khola	Rasuwa	5000	2058.04.09	2071.03.19
40	Joshi Hydropower Development Company Limited	Upper Puwa -1	Illam	3000	2066.01.23	2071.10.01
41	Sanima Mai Hydropower Limited	Mai Khola	Ilam	22000	2067.01.08	2071.10.14
42	Bojini Company Private Limited	Jiri Khola Small	Dolkha	2200	2065.10.23	2071.11.01
43	Ruru Hydropower Project (P) Ltd.	Upper Hugdi Khola	Gulmi	5000	2066.04.04	2071.12.09
44	Prime Hydropower Co. Pvt. Ltd.	Belkhu	Dhading	518	2064.04.04	2071.12.30
45	Api Power Company Pvt. Ltd.	Naugadh gad Khola	Darchula	8500	2067.01.19	2072.05.02
46	Kutheli Bukhari Small Hydropower (P).Ltd	Suspa Bukhari	Dolakha	998	2069.04.32	2072.06.03
47	Sanima Mai Hydropower Ltd.	Mai Cascade	Ilam	7000	2069.10.12	2072.10.29
48	Chhyangdi Hydropower Limited	Chhandi	Lamjung	2000	2068.12.23	2072.12.13
49	Panchakanya Mai Hydropower Ltd. (Previously Mai Valley and prior to that East Nepal)	Upper Mai Khola	Ilam	9980	2061.12.19	2073.03.09
50	Sayapatri Hydropower Private Limited	Daram Khola A	Baglung	2500	2068.12.19	2073.03.12
51	Electro-com and Research Centre Pvt. Ltd.	Jhyadi Khola	Sindhupalchowk	2000	2067.01.30	2073.05.31
52	Khani Khola Hydropower Company Pvt. Ltd.	Tungun-Thosne	Lalitpur	4360	2069.04.05	2073.07.09
53	Daraudi Kalika Hydro Pvt. Ltd.	Daraudi Khola A	Gorkha	6000	2068.05.19	2073.08.13
54	Khani Khola Hydropower Company Pvt. Ltd.	Khani Khola	Lalitpur	2000	2069.04.05	2073.08.20
55	Sapsu Kalika Hydropower Co. Pvt. Ltd.	Miya Khola	Khotang	996	2069.08.10	2073.09.03
56	Sinohydro-Sagarmatha Power Company (P) Ltd.	Upper Marsyangdi "A"	Lamjung	50000	2067.09.14	2073.09.17
57	Madi Power Pvt. Ltd.	Upper Madi	Kaski	25000	2066.05.21	2073.09.25
58	Panchthar Power Company Pvt. Ltd.	Hewa Khola A	Panchthar	14900	2068.05.30	2073.10.22
59	Sanvi Energy pvt. Ltd.	Jogmai	Ilam	7600	2069.08.07	2074.01.18
60	Bhugol Energy Dev Compay (P). Ltd	Dwari Khola	Dailekha	3750	2069.12.30	2074.1.23
61	Mai Valley Hydropower Private Limited	Upper Mai C	Ilam	5100	2068.12.23	2074.04.09
62	Dronanchal Hydropower Co.Pvt.Ltd	Dhunge-Jiri	Dolakha	600	2068.09.25	2074.06.01
63	Dibyaswari Hydropower Limited	Sabha Khola	Sankhuwasabha	4000	2068.11.17	2074.06.02
64	Puwa Khola-1 Hydropower P. Ltd.	Puwa Khola -1	Ilam	4000	2070.10.09	2074.06.23
65	Shibani Hydropower Co. Pvt. Ltd.	Phawa Khola	Taplejung	4950	2063.12.01	2074.07.14
66	Mount Kailash Energy Pvt. Ltd.	Thapa Khola	Myagdi	13600	2067.10.11	2074.08.22
67	Mandakini Hydropower Limited	Sardi Khola	Kaski	4000	2068.11.11	2074.08.23
68	Garjang Upatyaka Hydropower (P.) Ltd.	Chake Khola	Ramechhap	2830	2065.11.06	2074.08.28
69	Union Hydropower Pvt Ltd.	Midim Karapu	Lamjung	3000	2069.10.28	2074.10.15
70	Syauri Bhumey Microhydro Project	Syauri Bhumey	Nuwakot	23	2072.11.16	2074.10.18
71	Molung Hydropower Company Pvt. Ltd.	Molung Khola	Okhaldhunga	7000	2069.11.21	2074.12.12
72	Sikles Hydropower Pvt. Ltd.	Madkyu Khola	Kaski	13000	2066.08.03	2074.12.19
73	Himal Dolkha Hydropower Company Ltd.	Mai sana Cascade	Ilam	8000	2069.11.14	2074.12.26
74	Barahi Hydropower Pvt.ltd	Theule Khola	Baglung	1500	2066.12.16	075.03.24
75	Leguwa Khola Laghu Jalbidhyut Sahakari Sastha Ltd.	Leguwa Khola	Dhankuta	40	2072.11.21	2075.03.28
			TOTAL	512,695.40		

NEPAL ELECTRICITY AUTHORITY
POWER TRADE DEPARTMENT
IPPs' Hydropower Projects (Under Construction) as of FY 2074/75

S.N.	Developers	Projects	Location	Installed Capacity (kW)	PPA Date	Required Commercial Operation Date
1	Eastern Hydropower Pvt. Ltd.	Pikhuwa Khola	Bhojpur	5000	2066.07.24	2076.03.30
2	Upper Tamakoshi Hydropower Ltd.	Upper Tamakoshi	Dolkha	456000	2067.09.14	2072.9.10 - 4 Units, 2073.3.30 - 2 Units
3	Nama Buddha Hydropower Pvt. Ltd.	Tinau Khola Small	Palpa	1665	2065.03.31	2066.11.1 (990kw) 2077.09.15 (675kw)
4	Himalayan Hydropower Pvt. Ltd.	Namarjun Madi	Kaski	11800	2066.05.30	2071.4.1
5	Jumdi Hydropower Pvt. Ltd.	Jumdi Khola	Gulmi	1750	2066.10.21	2069.10.11
6	Hira Ratna Hydropower P.ltd	Tadi Khola	Nuwakot	5000	2067.01.09	2075.10.01
7	Energy Engineering Pvt. Ltd.	Upper Mailung A	Rasuwa	6420	2067.03.25	2075.10.01
8	Teleye Samyak Hydropower Company Pvt. Ltd.	Dhansi Khola	Rolpa	955	2067.04.12	2069.11.28
9	Shiva Shree Hydropower (P.) Ltd.	Upper Chaku A	Sindhupalchowk	22200	2067.05.22	2073.01.25
10	Greenlife Energy Pvt. Ltd.	Khani khola-1	Dolakha	40000	2067.06.24 2074.02.21	2074.12.17 (25MW) 2076.09.03 (15MW)
11	Himalaya Urja Bikas Co. Pvt. Ltd.	Upper Khimti	Ramechhap	12000	2067.10.09	2075.3.32
12	Green Ventures Pvt. Ltd.	Likhu-IV	Ramechhap	52400	2067.10.19	2077.06.30
13	Robust Energy Ltd.	Mistri Khola	Myagdi	42000	2067.10.20	2076.05.14
14	Manang Trade Link Pvt. Ltd.	Lower Modi	Parbat	20000	2068.05.20	2074.3.31
15	Mathillo Mailung Khola Jalbidhyut Ltd. (Prv. Molnia Power Ltd.)	Upper Mailun	Rasuwa	14300	2068.05.23	2075.10.01
16	Sanjen Hydropower Co.Limited	Upper Sanjen	Rasuwa	14800	2068.06.23	2075.10.01
17	Middle Bhotekoshi Jalbidhyut Company Ltd.	Middle Bhotekoshi	Sindhupalchowk	102000	2068.07.28	2076.12.28
18	Chilime Hydro Power Company Ltd.	Rasuwagadhi	Rasuwa	111000	2068.07.28	2075.10.01
19	Water and Energy Nepal Pvt. Ltd.	Badi Gad	Baglung	6600	2068.08.13	2072.2.14
20	Sanjen Hydropower Company Limited	Sanjen	Rasuwa	42500	2068.08.19	2075.10.01
21	Gelun Hydropower Co.Pvt.Ltd	Gelun	Sindhupalchowk	3200	2068.09.25	2074.06.14
22	Dariyal Small Hydropower Pvt.Ltd	Upper Belkhu	Dhading	750	2068.11.28	2071.7.16
23	Suryakunda Hydroelectric Pvt. Ltd.	Upper Tadi	Nuwakot	11000	2068.12.03	2075.10.01
24	Himalayan Power Partner Pvt. Ltd.	Dordi Khola	Lamjung	27000	2069.03.01	2076.05.14
25	Sasha Engingeering Hydropower (P). Ltd	Khani Khola (Dolakha)	Dolakha	30000	2069.03.25	2074.12.17
26	Arun Kabeli Power Ltd.	Kabeli B-1	Taplejung, Panchthar	25000	2069.03.29	2075.01.09
27	Rising Hydropower Compnay Ltd.	Selang Khola	Sindhupalchowk	990	2069.03.31	2071.6.15
28	Liberty Hydropower Pvt. Ltd.	Upper Dordi A	Lamjung	25000	2069.06.02	2076.05.14
29	Hydro Innovation Pvt. Ltd.	Tinekhu Khola	Dolakha	990	2069.06.08	2074.12.30
30	Salankhu Khola Hydropower Pvt. Ltd.	Salankhu Khola	Nuwakot	2500	2069.06.14	2071.11.30
31	Moonlight Hydropower Pvt. Ltd.	Balephi A	Sindhupalchowk	10600	2069.07.14	2076.12.28
32	Middle Modi Hydropower Ltd.	Middle Modi	Parbat	15100	2069.08.21	2077.03.31
33	Reliable Hydropower Co. Pvt. Ltd.	Khorunga Khola	Terhathum	4800	2069.08.26	2077.08.16
34	Rara Hydropower Development Co. Pvt. Ltd.	Upper Parajuli Khola	Dailekh	2150	2069.08.28	2071.12.17
35	Lohore Khola Hydropower Co. Pvt. Ltd.	Lohore Khola	Dailekh	4200	2069.09.08	2073.06.20

36	Beni Hydropower Project Pvt. Ltd.	Upper Solu	Solukhumbu	18000	2069.09.16	2074.10.01
37	Dudhkoshi Power Company Pvt. Ltd.	Rawa Khola	Khotang	6500	2069.09.26	2073.05.31
38	Universal Power Company Ltd.	Lower Khare	Dolakha	11000	2069.10.22	2074.9.16 (8.26MW) 2076.04.03 (2.74MW)
39	Mandu Hydropower Ltd.	Bagmati Khola Small	Makawanpur/Lalitpur	22000	2069.10.07	2076.03.30 (20MW) 2077.05.30 (2MW)
40	Madhya Midim Jalbidhyut Company P. Ltd.	Middle Midim	Lamjung	3100	2069.10.23	2072.5.1
41	Volcano Hydropower Pvt. Ltd.	Teliya Khola	Dhankuta	996	2069.10.25	2071.7.24
42	Bindhyabasini Hydropower Development Co. (P.) Ltd.	Rudi Khola A	Lamjung and Kaski	8800	2069.10.28	2076.02.32
43	Betrawoti Hydropower Company (P).Ltd	Phalankhu Khola	Rasuwa	13700	2069.12.06	2075.10.01
44	Himalaya Urja Bikas Co. Ltd.	Upper Khimti II	Ramechhap	7000	2069.12.09	2075.12.01
45	Salmanidevi Hydropower (P). Ltd	Kapadi Gad	Doti	3330	2069.12.11	2073.08.15
46	Dovan Hydropower Company Pvt. Ltd.	Junbesi Khola	Solukhumbu	5200	2069.12.29	2076.08.30
47	Ghalemdi Hydro Limited (Previously, Cemat Power Dev Company (P). Ltd.)	Ghalemdi Khola	Myagdi	5000	2069.12.30	2074.07.30 (4MW) 2077.05.03(1MW)
48	Tallo Midim Jalbidhut Company Pvt. Ltd.	Lower Midim	Lamjung	996	2070.01.19	2071.8.1
49	Rairang Hydropower Development Company Ltd.	Iwa Khola	Taplejung	9900	2070.01.29	2075.4.1
50	Tangchhar Hydro Pvt. Ltd	Tangchhahara	Mustang	2200	2070.02.20	2073.7.1
51	Abiral Hydropower Co. Pvt. Ltd.	Upper Khadam	Morang	990	2070.02.21	2071.08.01
52	Manakamana Engineering Hydropower Pvt. Ltd.	Ghatte Khola	Dolakha	5000	2070.04.28	2075.03.16
53	Essel-Clean Solu Hydropower Pvt. Ltd.	Lower Solu	Solukhumbu	82000	2070.07.15	2076.8.30
54	Consortium Power Developers Pvt. Ltd.	Khare Khola	Dolakha	24100	2070.07.15	2075.08.15
55	Upper Solu Hydroelectric Company Pvt. Ltd	Solu Khola	Solukhumbu	23500	2070.07.24	2075.4.1
56	Singati Hydro Energy Pvt. Ltd.	Singati Khola	Dolakha	25000	2070.07.27	2075.05.31 (16MW) 2077.04.01 (9MW)
57	Maya Khola Hydropower Co. Pvt. Ltd.	Maya Khola	Sankhuwasabha	14900	2070.08.30	2076.9.1
58	Idi Hydropower Co. P. Ltd.	Idi Khola	Kaski	975	2070.09.01	2074.09.16
59	Buddha Bhumi Nepal Hydro Power Co. Pvt. Ltd.	Lower Tadi	Nuwakot	4993	2070.12.10	2075.10.01
60	Mountain Hydro Nepal Pvt. Ltd.	Tallo Hewa Khola	Panchthar	21600	2071.4.9	2075.01.09
61	Bindhyabasini Hydropower Development Co. (P.) Ltd.	Rudi Khola B	Lamjung and Kaski	6600	2071.4.20	2076.02.32
62	Dordi Khola Jal Bidyut Company Ltd.	Dordi-1 Khola	Lamjung	10300	2071.07.19	2076.08.16
63	River Falls Hydropower Development Pvt. Ltd.	Down Piluwa	Sankhuwasabha	9500	2071.10.18	2076.09.01
64	Rangoon Khola Hydropower Pvt. Ltd.	Jeuligad Small	Bajhang	996	2071.10.20	2075.03.32
65	Peoples' Hydropower Company Pvt. Ltd.	Super Dordi 'Kha'	Lamjung	49600	2071.11.13	2077.03.29
66	Hydro Venture Private Limited	Solu Khola (Dudhkoshi)	Solukhumbu	86000	2071.11.13	2077.06.10
67	Global Hydropower Associate Pvt. Ltd.	Likhu-2	Solukhumbu/Ramechap	33400	2071.11.19	2077.04.01
68	Paan Himalaya Energy Private Limited	Likhu-1	Solukhumbu/Ramechap	51400	2071.11.19	2077.04.01
69	Numbur Himalaya Hydropower Pvt. Ltd.	Likhu Khola A	Solukhumbu/Ramechap	24200	2071.11.22	2077.04.01
70	Dipsabha Hydropower Pvt. Ltd.	Sabha Khola A	Sankhuwasabha	9990	2071.12.02	2076.07.15
71	Research and Development Group Pvt. Ltd.	Rupse Khola	Myagdi	4000	2071.12.17	2076.08.02
72	Hydro Empire Pvt. Ltd.	Upper Myagdi	Myagdi	20000	2071.12.17	2077.05.30
73	Chandeshwori Mahadev Khola MH. Co. Pvt. Ltd.	Chulepu Khola	Ramechhap	8520	2071.12.23	2075.04.15
74	Nyadi Hydropower Limited	Nyadi	Lamjung	30000	2072.02.12	2077.01.06
75	Suri Khola Hydropower Pvt. Ltd.	Suri Khola	Dolakha	6400	2072.02.20	2074.12.30

76	Bungal Hydro Pvt. Ltd. (Previously Sanigad Hydro Pvt. Ltd.)	Upper Sanigad	Bajhang	10700	2072.03.15	2076.05.29
77	Kalanga Hydro Pvt. Ltd.	Kalangagad	Bajhang	15330	2072.03.15	2076.05.29
78	Sanigad Hydro Pvt. Ltd.	Upper Kalangagad	Bajhang	38460	2072.03.15	2077.04.15
79	Dhaulagiri Kalika Hydro Pvt. Ltd.	Darbang-Myagdi	Myagdi	25000	2072.04.28	2075.12.25
80	Menchhiyam Hydropower Pvt. Ltd.	Upper Piluwa Khola 2	Sankhuwasabha	4720	2072.05.11	2076.04.01
81	Kabeli Energy Limited	Kabeli-A	Panchthar and Taplejung	37600	2072.06.07	2076.11.03
82	Upper Syange Hydropower P. Ltd.	Upper Syange Khola	Lamjung	2400	2072.06.14	2075.10.01
83	Peoples Energy Ltd. (Previously Peoples Hydro Co-operative Ltd.)	Khimti-2	Dolakha and Ramechhap	48800	2072.06.14	2078.04.01
84	Chauri Hydropower (P.) Ltd.	Chauri Khola	Kavrepalanchowk, Ramechhap, Sindhupalchowk, Dolakha	5000	2072.06.14	2075.12.30
85	Pashupati Environmental Power Co. Pvt. Ltd.	Lower Chhote Khola	Gorkha	997	2072.08.04	2076.05.15
86	Huaning Development Pvt. Ltd.	Upper Balephi A	Sindhupalchowk	36000	2072.08.29	2075.10.06
87	Upper Hewa Khola Hydropower Co. Pvt. Ltd.	Upper Hewa Khola Small	Sankhuwasabha	8500	2072.09.23	2076.03.17
88	Multi Energy Development Pvt. Ltd.	Langtang Khola	Rasuwa	20000	2072.09.29	2076.12.30 (10MW) 2078.04.03 (10MW)
89	Ankhu Hydropower (P.) Ltd.	Ankhu Khola	Dhading	34000	2073.01.30	2076.12.30
90	Myagdi Hydropower Pvt. Ltd.	Ghar Khola	Myagdi	14000	2073.02.11	2076.08.30 (8.3 MW) 2078.10.17 (5.7 MW)
91	Richet Jalbidhyut Company Pvt. Ltd.	Richet Khola	Gorkha	4980	2073.02.23	2075.03.31
92	United Idi Mardi and R.B. Hydropower Pvt. Ltd.	Upper Mardi	Kaski	7000	2073.02.25	2075.04.01
93	Rapti Hydro and General Construction Pvt. Ltd.	Rukumgad	Rukum	5000	2073.03.07	2076.09.01
94	Rawa Energy Development Pvt. Ltd.	Upper Rawa	Khotang	2800	2073.04.24	2076.03.30
95	Siddhi Hydropower Company Pvt. Ltd.	Siddhi Khola	Illam	10000	2074.05.29	2077.03.31
96	Api Power Company Pvt. Ltd.	Upper Naugad Gad	Darchula	8000	2073.07.12	2077.04.01
97	Terhathum Power Company Pvt. Ltd.	Upper Khorunga	Terhathum	7500	2073.07.29	2076.09.01
98	Nilgiri Khola Hydropower Co. Ltd.	Nilgiri Khola	Myagdi	38000	2073.11.30	2080.08.30
99	Super Mai Hydropower Pvt. Ltd.	Super Mai	Illam	7800	2073.12.06	2077.04.01
100	Siuri Nyadi Power Pvt. Ltd.	Super Nyadi	Lamjung	40270	2074.02.19	2079.04.01
101	Swet-Ganga Hydropower and Construction Ltd.	Lower Likhu	Ramechhap	28100	2073.09.14	2078.08.15
102	Nilgiri Khola Hydropower Co. Ltd.	Nilgiri Khola-2	Myagdi	62000	2074.03.05	2081.08.30
103	Sano Milti Khola Hydropower Ltd.	Sano Milti	Ramechhap and Dolakha	3000	2073.01.13	2075.08.01
104	Diamond Hydropower Pvt. Ltd.	Upper Daraudi-1	Gorkha	10000	2072.08.14	2075.09.17
105	Chhyangdi Hydropower Limited	Upper Chhyangdi Khola	Lamjung	4000	2074.03.22	2078.04.05
106	Taksar-Pikhuwa Hydropower Pvt. Ltd.	Taksar Pikhuwa	Bhojpur	8000	2073.09.01	2076.10.23
107	Rasuwa Hydropower Pvt. Ltd	Phalanku Khola	Rasuwa	5000	2071.08.24	2076.08.01
			TOTAL	**2,356,313**		

NEPAL ELECTRICITY AUTHORITY
POWER TRADE DEPARTMENT
IPPs' Hydropower Projects in Different Stages of Development as of FY 2074/75
(Without Financial Closure)

S.N.	Developers	Projects	Location	Installed Capacity (kW)	PPA Date	RCOD
1	Balephi Jalbidhyut Co. Ltd.	Balephi	Sindhupalchowk	23520	2067.09.08	2077.06.30
2	Ingwa Hydro Power Pvt. Ltd	Upper Ingwa khola	Taplejung	9700	2068.03.10	2073.04.01
3	Deurali Bahuudesiya Sahakari Sanstha Ltd.	Midim Khola	Lamjung	100	2070.02.20	2070.5.1
4	Ludee Hydropower Development Co. Pvt.Ltd	Ludee Khola	Gorkha	750	2071.4.21	2073.4.1
5	Makari Gad Hydropower Pvt. Ltd.	Makarigad	Darchula	10000	2072.08.29	2076.02.32
6	Civil Hydropower Pvt. Ltd.	Bijayapur 2 Khola Small	Kaski	4500	2072.09.12	2075.03.32
7	Yambling Hydropower Pvt. Ltd.	Yambling Khola	Sindhupalchowk	7270	2072.09.29	2077.03.17
8	United Modi Hydropwer Ltd.	Lower Modi 2	Parbat	10500	2072.11.14	2076.03.17
9	Salasungi Power Limited	Sanjen Khola	Rasuwa	78000	2072.12.02	2077.03.08
10	Siddhakali Power Limited	Trishuli Galchi	Nuwakot and Dhading	75000	2073.02.20	2077.02.01
11	Him River Power Pvt. Ltd.	Liping Khola	Sindhupalchowk	16260	2073.02.28	2077.01.22
12	Chirkhwa Hydropower Pvt. Ltd.	Upper Chirkhwa	Bhojpur	4700	2073.03.01	2077.04.01
13	Energy Venture Pvt. Ltd.	Upper Lapche	Dolakha	52000	2073.04.20	2078.12.30
14	Sindhujwala Hydropower Ltd.	Upper Nyasem	Sindhupalchowk	41400	2073.07.24	2077.03.30
15	Samling Power Company Pvt. Ltd.	Mai Beni	Illam	9008	2073.07.26	2078.08.02
16	Tamor Sanima Energy Pvt. Ltd.	Middle Tamor	Taplejung	52100	2073.09.26	2078.05.28
17	Daram Khola Hydro Energy Ltd.	Daram Khola	Baglung and Gulmi	7300	2073.10.09	2076.09.08
18	Pahadi Hydro Power Company (P.) Ltd.	Madhya Tara Khola Small	Baglung	1700	2073.10.26	2075.08.29
19	Himal Hydro and General Construction Ltd.	Super Madi	Kaski	44000	2073.10.27	2078.02.28
20	Sisa Hydro Electric Company Pvt. Ltd.	Sisa Khola A	Solukhumbu	2800	2073.10.28	2077.12.12
21	Chirkhwa Hydropower Pvt. Ltd.	Lower Chirkhwa	Bhojpur	4060	2074.01.20	2078.04.01
22	Him Consult Pvt. Ltd.	Rele Khola	Myagdi	6000	2074.01.28	2077.02.19
23	Himali Rural Electric Co-operative Ltd.	Leguwa Khola Small	Dhankuta	640	2074.02.08	2075.12.28
24	Sabha Pokhari Hydro Power (P.) Ltd.	Lankhuwa Khola	Sankhuwasabha	5000	2074.02.21	2077.09.14
25	United Mewa Khola Hydropower Pvt. Ltd.	Mewa Khola	Taplejung	50000	2074.02.21	2078.04.01
26	Parbat Paiyun Khola Hydropower Company Pvt. Ltd.	Seti Khola	Parbat	3500	2074.02.22	2076.12.30
27	Sewa Hydro Ltd.	Lower Selang	Sindhupalchowk	1500	2074.02.22	2075.12.30
28	Gorakshya Hydropower Pvt. Ltd.	Super Ankhu Khola	Dhading	23500	2074.03.15	2080.09.15
29	Orbit Energy Pvt. Ltd. (Previously Pokhari Hydropower Company Pvt. Ltd.)	Sabha Khola B	Sankhuwasabha	15100	2074.03.26	2078.2.31
30	Nyam Nyam Hydropower Company Pvt. Ltd.	Nyam Nyam Khola	Rasuwa	6000	2074.03.27	2077.12.31
31	Surya Power Company Pvt. Ltd.	Bishnu Priya Solar Farm Project	Nawalparasi	960	2074.04.08	2074.04.17
32	Saptang Hydro Power Pvt. Ltd.	Saptang Khola	Nuwakot	2500	2074.04.08	2076.04.12
33	Jhyamolongma Hydropower Development Company Pvt. Ltd.	Karuwa Seti	Kaski	32000	2074.04.20	2079.01.12
34	Century Energy Pvt. Ltd.	Hadi Khola Sunkoshi A	Sindhupalchowk	997	2074.05.05	2076.11.03

35	People's Power Limited	Puwa - 2	Illam	4960	2074.05.05	2078.06.11
36	Trishuli Hydropower Company Ltd.	Upper Trishuli 3B	Rasuwa	37000	2074.05.06	2078.11.17
37	Mount Nilgiri Hydropower Company Pvt. Ltd.	Rurubanchu-1	Kalikot	13500	2074.05.08	2077.11.03
38	Bhujung Hydropower Pvt. Ltd.	Upper Midim	Lamjung	7500	2074.05.29	2078.04.01
39	Himalayan Water Resources and Energy Development Co. Pvt. Ltd.	Upper Chauri	Kavrepalanchowk	6000	2074.07.27	2078.04.04
40	Nasa Hydropower Pvt. Ltd.	Lapche Khola	Dolakha	99400	2074.07.29	2079.04.14
41	Dolti Power Company Pvt. Ltd.	Padam Khola	Dailekh	4800	2074.08.01	2077.11.08
42	IDS Energy Pvt. Ltd.	Lower Khorunga	Terhathum	5400	2074.08.24	2078.04.01
43	Langtang Bhotekoshi Hydropower Company Pvt. Ltd.	Rasuwa Bhotekoshi	Rasuwa	120000	2074.09.07	2078.09.07
44	Upper Richet Hydropower Pvt. Ltd.	Upper Richet	Gorkha	2000	2074.09.20	2077.04.01
45	Him Star Urja Co. Pvt. Ltd.	Buku Kapati	Okhaldhunga and Solukhumbu	5000	2074.10.11	2077.04.15
46	Khechereswor Jal Vidhyut Pvt. Ltd.	Jadari Gad Small	Bajhang	1000	2074.10.12	2077.07.30
47	Khechereswor Jal Vidhyut Pvt. Ltd.	Salubyani Gad Small	Bajhang	233	2074.10.12	2077.09.29
48	Nepal Water and Energy Development Company Pvt. Ltd.	Upper Trishuli - 1	Rasuwa	216000	2074.10.14	2080.12.18
49	Gaughar Ujjyalo Sana Hydropower Co. Pvt. Ltd.	Ghatte Khola Small	Sindhupalchowk	970	2074.11.11	2077.03.01
50	Unitech Hydropower Co. Pvt. Ltd.	Upper Phawa	Taplejung	5800	2074.11.11	2078.04.16
51	Seti Khola Hydropower Pvt. Ltd.	Seti Khola	Kaski	22000	2074.11.11	2079.04.15
52	Sagarmatha Jalabidhyut Company Pvt. Ltd.	Super Mai 'A'	Illam	9600	2074.11.14	2077.09.29
53	Chimal Gramin Bidhyut Sahakari Sanstha Ltd.	Sobuwa Khola-2 MHP	Taplejung	90	2074.11.15	2074.11.30
54	Vision Energy and Power Pvt. Ltd.	Nupche Likhu	Ramechhap	57500	2074.11.28	2080.05.02
55	Omega Energy Developer Pvt. Ltd.	Sunigad	Bajhang	11050	2074.11.30	2080.02.07
56	Mai Khola Hydropower Pvt. Ltd.	Super Mai Cascade	Illam	3800	2074.12.07	2078.04.01
57	Asian Hydropower Pvt. Ltd.	Lower Jogmai	Illam	6200	2074.12.07	2078.04.01
58	Gaurishankar Power Development Pvt. Ltd.	Middle Hyongu Khola B	Solukhumbu	22900	2074.12.08	2079.04.01
59	Upper Lohore Khola Hydropower Co. Pvt. Ltd.	Upper Lohore	Dailekh	4000	2074.12.08	2077.04.11
60	Super Hewa Power Company Pvt. Ltd.	Super Hewa	Sankhuwasabha	5000	2074.12.27	2078.04.01
61	Khimti Gramin Bidhyut Sahakari Sanstha Ltd.	Jhankre Khola Small	Dolakha	600	2075.02.04	2076.05.14
62	Baraha Multipower Pvt. Ltd.	Irkhuwa Khola B	Bhojpur	15524	2075.02.14	2079.04.15
63	Aashutosh Energy Pvt. Ltd.	Chepe Khola Small	Lamjung	8630	2075.02.15	2078.11.09
64	Lower Irkhuwa Hydropower Co. Pvt. Ltd.	Lower Irkhuwa	Bhojpur	13040	2075.02.16	2079.04.03
65	Sungava Foundation Pvt. Ltd.	Thulo Khola	Myagdi	21300	2075.02.17	2079.04.15
66	Jhilimili Hydropower Co. Pvt. Ltd.	Gulangdi Khola	Gulmi	980	2075.02.24	2078.01.14
67	North Summit Hydro Pvt. Ltd.	Nyadi Phidi	Lamjung	21400	2075.02.24	2079.12.15
68	Himali Hydro Fund Pvt. Ltd.	Sona Khola	Taplejung	9000	2075.03.14	2080.07.30
69	Tanahun Hydropower Ltd.	Tanahun	Tanahun	140000	2075.03.15	2080.12.30
70	Sailung Power Company Pvt. Ltd.	Bhotekoshi-1	Sindhupalchowk	40000	2075.03.15	2079.07.01
71	Jalshakti Hydro Company Pvt. Ltd.	Ilep (Tatopani)	Dhading	23675	2075.03.25	2081.08.25
72	Three Star Hydropower Company Ltd.	Sapsup Khola	Khotang	6600	2075.03.25	2078.06.31
73	Tundi Power Pvt.Ltd	Rahughat Mangale	Myagdi	35500	2075.03.29	2079.08.29
74	Tundi Power Pvt.Ltd	Upper Rahughat	Myagdi	48500	2075.03.29	2080.08.29
			Total	**1,658,817**		

Power Purchase Agreements Terminated as of FY 2074/75

S.N.	Developer	Project	Location	Capacity (kW)	Reason for Termination
1	TMB Energietechnik	Narayani Shankar Biomass	Rupandehi	600	Event of Default
2	Jywala Sajhedari Hydropower Company Pvt. Ltd.	Tame Khola	Dailekh	1250	Event of Default
			Total	1850	

IPPs' Hydro Power Projects with Issurance of Notice of Default as of FY 2074/75

S.N.	Developers	Projects	Location	Installed Capacity (kW)	PPA Date
1	Jumdi Hydropower Pvt. Ltd.	Jumdi Khola	Gulmi	1750	2066.10.21
2	Teleye Samyak Hydropower Company Pvt. Ltd.	Dhansi Khola	Rolpa	955	2067.04.12
3	Ingwa Hydro Power Pvt. Ltd	Upper Ingwa khola	Taplejung	9700	2068.03.10
4	Water and Energy Nepal Pvt. Ltd.	Badi Gad	Baglung	6600	2068.08.13
5	Salankhu Khola Hydropower Pvt. Ltd.	Salankhu Khola	Nuwakot	2500	2069.06.14
6	Lohore Khola Hydropower Co. Pvt. Ltd.	Lohore Khola	Dailekh	4200	2069.09.08
7	Volcano Hydropower Pvt. Ltd.	Teliya Khola	Dhankuta	996	2069.10.25
8	Tallo Midim Jalbidhut Company Pvt. Ltd.	Lower Midim	Lamjung	996	2070.01.19
9	Tangchhar Hydro Pvt. Ltd	Tangchhahara	Mustang	2200	2070.02.20
10	Ludee Hydropower Development Co. Pvt. Ltd.	Ludee Khola	Gorkha	750	2071.04.21
			Total	**30,647**	

०७४ साउन १ गतेदेखि ०७५ असार मसान्तसम्म विभागीय कारबाही भएका कर्मचारीहरूको नामावली

नसिहत

क्र.सं.	क.स नं.	पद	तह	नाम/थर	पत्रको मिति	निर्णय मिति	कार्यालय	कैफियत
१	नचछ ८१७५	ईन्जिनियर	७	श्री दिपक सापकोटा	६/१०/२०७४	६/९/२०७४	धरान वितरण केन्द्र	
२	गधन ३१७४	सु.भा.	५	श्री सन्तोष ढकाल	६/१०/२०७४	६/९/२०७४	बेलवारी वितरण केन्द्र	
३	घड ६४०	मि.रि.सु.भा.	५	श्री राजेन्द्र तिवारी	६/१० २०७४	६/८/२०७४	धरान वितरण केन्द्र	
४	छज १७००५७	स.प्रवन्धक	८	श्री सुरज दाहाल	८/५/२०७४	७/३०/२०७४	देविघाट जलविद्युत केन्द्र	
५	छ १७०३३९	ईन्जिनियर	७	श्री हरिशचन्द्र घिताल	८/५/२०७४	७/३०/२०७४	सेतिफेवा जलविद्युत केन्द्र	
६	नच ८२७२	स.ईन्जिनियर	६	श्री तेजकान्त उपाध्याय	८/५/२०७४	७/३०/२०७४	कुलेखानी दोस्रो जलविद्युत के.	
७	झपफब ८७१६	स.निर्देशक	८	श्री रमेश कुमार कार्की	८/१४/२०७४	८/८/२०७४	रत्नपार्क वितरण केन्द्र	
८	पफ १२८१९	स.निर्देशक	८	श्री टिकादत्त ढकाल	८/१४/२०७४	८/८/२०७४	रत्नपार्क वितरण केन्द्र	
९	छज ११९४७	उप-प्रवन्धक	९	श्री गीर बहादुर के.सी.	१०/२९/२०७४	१०/१९/२०७४	सुनकोशी जलविद्युत केन्द्र	
१०	झ ८८९०	हेड गार्ड	५	श्री भुवन बहादुर क्षेत्री	१०/२९/२०७४	१०/१९/२०७४	कालीगण्डकी ए ज.वि.के	

सचेत गराएको

क्र.सं.	क.स.नं.	पद	तह	नाम/थर	लागुहुने मिति	निर्णय मिति	कार्यालय	कैफियत
१	छजझ ११६८९	उप-प्रवन्धक	९	श्री दिपेन्द्र राज दिवेदी	४/१/२०७४	३/२८/२०७४	कावेली कोरीडोर	
२	छज ११९२५	सहायक प्रबन्धक	८	श्री नवल किशोर गोईत	६/२/२०७४	४/१७/२०७४	काठमाण्डौं ग्रीड महाशाखा	
३	छज ११९३१	सहायक प्रबन्धक	८	श्री शेर बहादुर सुनार	६/२/२०७४	४/१७/२०७४	सामुदायीक ग्रा.वि.विभाग	
४	छज ११९००	सहायक प्रबन्धक	८	श्री चुटुन कुमार श्रीवास्तव	८/८/२०७४	८/४/२०७४	बीरगञ्ज वितरण केन्द्र	
५	छज ११८५२	सहायक प्रबन्धक	८	श्री ऋषि कुमार बरनवाल	८/४/२०७४	८/८/२०७४	विराटनगर क्षेत्रीय कार्यालय	

स्वतः अवकाश

क्र.सं.	क.स.नं.	पद	तह	नाम/थर	लागुहुने मिति	निर्णय मिति	कार्यालय	कैफियत
१	क ११०२७९	जु.हे.	१	श्री चित्र बहादुर मगर	10/10/2073	5/12/2074	मर्स्याङ्गदी ज.वि.के.	
२	छज १७००६3	स.प्रवन्धक	८	श्री सुनिलराज पौडेल	6/20/2072	5/22/2074	माटो ढुङ्गा प्रयोगसाला	
३	छज ११७६२	छज ११७६२	८	श्री कल्याण मल्ल	1/3/2073	6/6/2074	बुटवल क्षेत्रीय कार्यालय	

राजिनामा

क्र.सं.	क.स.नं.	पद	तह	नाम/थर	लागुहुने मिति	निर्णय मिति	कार्यालय	कैफियत
१	कख ६१५	हेल्पर	२	श्री खड्ग बहादुर बिष्ट	३/२७/२०७४	५/१६/२०७४	वेलवारी वितरण केन्द्र	
२	झपफ ८७२७	ले.अ.	७	श्री सुशिल प्रसाद खनाल	६/२२/२०७४	६/२२/२०७४	प्रधान कार्यालय	
३	घझप ३६१४	स.प्र.अ.	६	श्री हरिकृष्ण श्रेष्ठ	७/१/२०७४	६/२८/२०७४	विभागीय कारवाही शाखा	
४	छ १७०१७५	ईन्जिनियर	७	श्री विजय दाहाल	८/८/२०७४	७/१४/२०७४	बुटवल क्षेत्रीय कार्यालय	
५	गधन २७००	सु.भा.	५	श्री हेम बहादुर सिंतान	७/२६/२०७४	८/८/२०७४	हेटौंडा क्षेत्रीय कार्यालय	
६	धन ७०९५	सु.भा	५	श्री खेम बहादुर राना	७/२१/२०७४	९/२८/२०७४	हेटौंडा वितरण केन्द्र	
७	ध १४०२०७	फो.मे.	४	श्री विनोद कुमार यादव	४/२५/२०७४	५/६/२०७४	काठमाण्डौं ग्रीड महाशाखा	
८	छ १७०३५८	जियोलोजिष्ट	७	श्री विनोद महर्जन	७/१२/२०७४	१०/२५/२०७४	दुधकोशी ज.ज. आ.	
९	कखग ७२९	ई.सि.	३	श्री विष्णुबहादुर अधिकारी	९/१९/२०७४	१०/२९/२०७४	इटहरी वितरण केन्द्र	
१०	न १५०२७१	सु.भा.	५	श्री सुनिता भेले	१०/११/२०७४	१२/५/२०७४	काठमाण्डौं ग्रीड महाशाखा	

निलम्वन

क्र.सं.	क.स.नं.	पद	तह	नाम/थर	लागुहुने मिति	निर्णय मिति	कार्यालय	कैफियत
१	कखगध ७०२	फो.मे.	४	श्री गोविन्द न्यौपाने	४/१५/२०७४	५/२३/२०७४	दुहवी वितरण केन्द्र	
२	ग १३०२७०	ई.सि.	३	श्री जयराज न्यौपाने	७/७/२०७४	८/६/२०७४	नेपालगञ्ज वितरण केन्द्र	
३	कखगध ८७२	फो मे.	४	श्री इश्वर प्रसाद सुवेदी	८/२६/२०७४	९/७/२०७४	पोखरा वितरण केन्द्र	
४	खधन १६८७	सु.भा.	५	श्री दिनेश थापा	९/१७/२०७४	९/२६/२०७४	पाँचखाल उप-वितरण केन्द्र	
५	खग २२६०	ई.सि.	३	श्री निति बहादुर गुरुङग	१०/१८/२०७४	११/२/२०७४	मर्स्याङ्गदी ज.वि.के.	
६	कख १८४७	हेल्पर	२	श्री दिलिप कुमार यादव	११/२६/२०७४	१२/१२/२०७४	जनकपुर वितरण केन्द्र	
७	घछ ३४००४२	ईन्जिनियर	७	श्री रत्नेश्वर कुमार चौधरी	१२/२१/२०७४	१/२०/२०७५	कलैया वितरण केन्द्र	
८	खगध १६८३	सु.भा.	५	श्री बाबु साहेव सिंह राजपुत	१/५/२०७५	१/२८/२०७५	जलेश्वर वितरण केन्द	
९	ग ३७२३	ई.सि.	३	श्री लाल बाबु पण्डित	१/५/२०७५	१/२८/२०७५	जलेश्वर वितरण केन्द्र	
१०	ग १३००७७	ई.सि.	३	श्री संजिव कुमार साह	१/१२/२०७५	२/२/२०७५	जलेश्वर वितरण केन्द्र	
११	नचछ ७९९१	ईन्जिनियर	७	श्री निसार अहमद खाँन	१/२६/२०७५	२/१५/२०७५	नेपालगञ्ज वितरण केन्द्र	
१२	न १५०१९९	सु.भा.	५	श्री विक्रान्त शुक्ला	१/२६/२०७५	२/१५/२०७५	नेपालगञ्ज वितरण केन्द्र	

निलम्वन फुकुवा

क्र.सं.	क.स.नं.	पद	तह	नाम/थर	लागुहुने मिति	निर्णय मिति	कार्यालय	कैफियत
१	घड ३६५०	व.स.	५	श्री मात्रिका बजिमय	४/११/२०७४	६/२९/२०७४	वितरण तथा ग्रहक सेवा नि.	
२	तथ ५२२७	का.स.	२	श्री धन बहादुर बि.क.	६/५/२०७३	५/१४/२०७५	हेटौंडा वितरण केन्द्र	

स्वेच्छिक अवकाश

क्र.सं.	क स.न	पद	तह	नाम/थर	लागुहुने मिति	निर्णय मिति	कार्यालय	कैफियत
१	नचछ ७६७४	ईन्जिनियर	७	श्री दिव्यश्री जोशी	३/१/२०७४	३/२९/२०७४	संस्थागत योजना तथा अनुगमन वि.	
२	गध २८२९	फो मे.	४	श्री भरत सिंह राई	२/१/२०७४	४/६/२०७४	विराटनगर वितरण केन्द्र	
३	घङ ३७००	व.स.	५	श्री मित्र कुमार राई	४/२६/२०७४	८/१८/२०७४	केन्द्रीय लेखा विभाग	
४	घङ ३४७९	व.स.	५	श्री प्रभा प्याकुरेल	४/२६/२०७४	८/२३/२०७४	ईन्जिनियरिङ्ग सेवा निर्देशनालय	
५	कखग १२९०	इ सि	३	श्री मुरली बहादुर सिकारी	४/६/२०७४	४/२३/२०७४	कुलेखानी प्रथम ज वि के	
६	ङपफब ८५४४	स.निर्देशक	८	श्री रेनु कुमारी श्रेष्ठ जोशी	३/८/२०७४	४/२०/२०७४	वि.ग्रा.से.	
७	गध ७१४९	सि.हे.ई.अ.	५	श्री राजाराम कार्की	२०७४-०४-३२	५/२५/२०७४	किर्तिपुर वितरण केन्द्र	
८	धनच ७१०२	स.ईन्जिनियर	६	श्री नवराज पाण्डे	६/१/२०७४	५/२२/२०७४	जोरपाटी वितरण केन्द्र	
९	कख १५८६	हेल्पर	२	श्री मुक्त नारायण श्रेष्ठ	४/१/२०७४	६/६/२०७४	लेखनाथ वितरण केन्द्र	
१०	घङ ३५५१	मि रि सु.भा.	५	श्री होम बहादुर पाण्डे	५/१६/२०७४	६/२४/२०७४	किर्तिपुर वितरण केन्द्र	
११	घङ ६३६४	मि रि सु.भा.	५	श्री विनोद प्रसाद पाण्डे	६/२६/२०७४	६/२६/२०७४	वितरण तथा ग्राहक सेवा निर्देशनालय	
१२	घङप ३४०७	स.प्र.अ.	७	श्री अम्बिका प्रसाद ढुंगेल	७/१/२०७४	६/२९/२०७४	रत्नपार्क वितरण केन्द्र	
१३	घङ ३६८८	व.स.	५	श्री राज लक्ष्मी श्रेष्ठ	७/१/२०७४	७/१२/२०७४	उत्पादन निर्देशनालय	
१४	गध ३१७३	फो.मे.	४	श्री सूर्य कुमार श्रेष्ठ	६/४/२०७४	७/१९/२०७४	पाल्पा वितरण केन्द्र	
१५	घङ ३३६९	मि रि सु.भा.	५	श्री लक्ष्मण प्रसाद बस्याल	५/५/२०७४	७/२९/२०७४	गुल्मी वितरण केन्द्र	
१६	दङपफब ५५२८	सहायक निर्देशक	८	श्री प्रकाश खरेल	७/१५/२०७४	८/१२/२०७४	विराटनगर वितरण केन्द्र	
१७	गध ३१५२	फो.मे.	४	श्री राम बहादुर कार्की	८/१/२०७४	८/१२/२०७४	रामेछाप वितरण केन्द्र	
१८	गधन २९३०	सु.भा.	५	श्री बाबुराज श्रेष्ठ	९/१/२०७४	९/८/२०७४	आरुघाट वितरण केन्द्र	
१९	थदघङ ५२३१	मि.रि.सु.भा.	५	श्री मधुरा देवी पौडेल	९/२०/२०७४	९/४/२०७४	किर्तिपुर वितरण केन्द्र	
२०	कखग ७०८	ई.सि.	३	श्री गणेश प्रसाद भट्टराई	९/१/२०७४	१०/१५/२०७४	विराटनगर वितरण केन्द्र	
२१	खग १६५४	ई.सि.	३	श्री वेदराज भट्ट	८/१/२०७४	१०/१८/२०७४	प्युठान वितरण केन्द्र	
२२	पफबभम १२७५९	सह नि.	१०	श्री टंक प्रसाद श्रेष्ठ	१०/२०/२०७४	१०/२२/२०७४	वि.ग्रा.से.अर्थ महाशाखा	
२३	घङ ३५१९	मि.रि.सु.भा.	५	श्री टोल प्रसाद गौतम	८/२६/२०७४	१०/१५/२०७४	ठिमि वितरण केन्द्र	
२४	थखग ५२५४	ई सि	३	श्री कुल बहादुर खड्का	८/१५/२०७४	१०/२२/२०७४	पोखरा वितरण केन्द्र	
२५	घङप ३२३९	स.प्र.अ.	६	श्री लेखराज शर्मा	९/२३/२०७४	११/१०/२०७४	टिकापुर वितरण केन्द्र	
२६	दघङप ५६१२	स.ले.अ.	६	श्री तिलमान राई	९/२६/२०७४	११/१०/२०७४	कुलेश्वर वितरण केन्द्र	
२७	कख ९६४	हेल्पर	२	श्री दिपक तामाङ्ग	७/२६/२०७४	११/९/२०७४	कुलेश्वर वितरण केन्द्र	
२८	कखग ८९७	ई सि	३	श्री विष्णु प्रसाद शर्मा	१०/२९/२०७४	११/१६/२०७४	स्याङ्जा वितरण केन्द्र	
२९	गधन २८९८	सु.भा.	५	श्री अभिमन्यु हमाल	११/१५/२०७४	११/१६/२०७४	धादिङ वितरण केन्द्र	
३०	घङप ३४५७	स.प्र.अ.	६	श्री विनोद कायस्थ	१०/१०/२०७४	११/१८/२०७४	भक्तपुर वितरण केन्द्र	
३१	गधन २६५९	सु.भा.	५	श्री चन्द्र बहादुर गुरुङ्ग	७/२६/२०७४	११/१८/२०७४	गोरखा वितरण केन्द्र	
३२	कखग ११०६	ई.सि.	३	श्री कृष्ण प्रसाद सुवेदी	९/२६/२०७४	११/१८/२०७४	काठमाण्डौं ग्रीड महाशाखा	
३३	तथ ४८९४	का स.	२	श्री कृतिमान गुरुङ्ग	१२/१/२०७४	१२/२०/२०७४	गोरखा वितरण केन्द्र	
३४	कखग १३४०	ई.सि.	३	श्री चोक बहादुर मगर	११/२६/२०७४	१२/२६/२०७४	भोजपुर वितरण केन्द्र	
३५	घङपफ ३०५९	ले.अ.	७	श्री शम्भु वस्नेत	१/१/२०७५	१२/२२/२०७४	कर्मचारी कल्याण महाशाखा	
३६	खग २०८१	ई.सि.	३	श्री विदुर प्रसाद सिंखडा	११/२/२०७४	१२/२७/२०७४	बानेश्वर वितरण केन्द्र	
३७	दघङ ६३४७	मि.रि.सु.भा.	५	श्री लिला अधिकारी	१०/१५/२०७४	१/२/२०७५	महेन्द्रनगर वितरण केन्द्र	
३८	कखग २१७	ई सि	३	श्री च्याङ्वा लामा	१२/२६/२०७४	१/५/२०७५	रत्नपार्क वितरण केन्द्र	
३९	धनच ७१०४	स.ईन्जिनियर	६	श्री देवदास श्रेष्ठ	१२/२६/२०७४	१/९/२०७५	महाराजगञ्ज वितरण केन्द्र	
४०	छजझञ ११६३१	प्रवन्धक	१०	श्री प्रचेत कुमार श्रेष्ठ	१/१/२०७५	१/११/२०७५	प्राविधिक सपोर्ट विभाग	
४१	छञझञट ११५८३	निर्देशक	११	श्री संजय कुमार उपाध्याय	१/२५/२०७५	१/२८/२०७५	सूचना प्रविधि विभाग	
४२	दघङ ५८१०	मि.रि.सु.भा.	५	श्री केदार प्रसाद अर्याल	१२/२६/२०७४	१/२८/२०७५	ठिमि वितरण केन्द्र	
४३	तथ ५११२	का.स-२	२	श्री राम बहादुर खड्का	१२/९/२०७४	२/१३/२०७५	नुवाकोट वितरण केन्द्र	
४४	घङ ३६९८	मि रि सु.भा.	५	श्री अशोक कुमार क्षेत्री	१/४/२०७५	२/२८/२०७५	गल्मी वितरण केन्द्र	
४५	गधन २७७०	सु.भा.	५	श्री राजमान श्रेष्ठ	२/२६/२०७५	२/२८/२०७५	कीर्तिपुर वितरण केन्द्र	
४६	गधन ३०३०	सु भा	५	श्री विष्णु प्रसाद भट्टराई	२/२६/२०७५	२/२८/२०७५	गमगाढ वितरण केन्द्र	
४७	कखग ९०८	ई.सि.	३	गिरीस बहादुर चौधरी	१/२६/२०७५	२/२८/२०७५	परासी वितरण केन्द्र	
४८	गधन २९७०	सु भा	५	श्री मजनु महर्जन	१/२४/२०७५	२०७५-०२-३१	त्रिशुली जल विद्युत केन्दर	
४९	गधन २९८६	सु.भा.	५	श्री प्रेम शर्मा पौडेल	२/१/२०७५	३/५/२०७५	सेतीफेवा जल विद्युत केन्द्र	
५०	धनच ७११२	स.ईन्जिनियर	६	श्री मणी कुमार गौतम	२/२६/२०७५	२०७५-०२-३१	रत्नपार्क वितरण केन्द्र	
५१	नचछ ७९३८	ईन्जिनियर	७	श्री रमेश प्रसाद घिमिरे	११/१/२०७४	२/२८/२०७५	हेटौंडा-भरतपुर २२० के.भी.प्र.ला.आ.	
५२	घङप ३३३३	स.प्र.अ.	६	सुदन राज चालिसे	२/२६/२०७५	३/५/२०७५	वितरण तथा ग्राहक सेवा निर्देशनालय	
५३	कखगध ४२७	फो.मे.	४	रामचन्द्र बस्नेत	३/१६/२०७५	१/१६/२०७५	माटोढुङ्गा तथा कंक्रिट प्रयोगशाला	

सेवाबाट बर्खास्त गरिएको

क्र.सं.	क.स.नं.	पद	तह	नाम/थर	लागुहुने मिति	निर्णय मिति	कार्यालय	कैफियत
१	घङ ३५४०	व.स.	५	श्री ईन्दिरा सुवेदी (पोखरेल)	७/४/२०७१	९/३०/२०७४	तालिम केन्द्र विभाग	
२	धन ७६१०	सु.भा.	५	श्री उमेश कुमारयादव	१२/१७/२०७१	३/८/२०७५	चन्द्रनियाहपुर वितरण केन्द्र	

सेवाबाट हटाईएको

क्र.सं.	क.स.नं.	पद	तह	नाम/थर	लागुहुने मिति	निर्णय मिति	कार्यालय	कैफियत
१	घङ ३९०७	लेखापाल	५	श्री उमेश कुमार महत	३/६/२०७४	९/१४/२०७४	लगनखेल वितरण केन्द्र	

ग्रेड रोक्का

क्र.सं.	क.स.नं.	पद	तह	नाम/थर	पत्रको मिति	निर्णय मिति	कार्यालय	कैफियत
१	छ १७००११	ईन्जिनियर	७	श्री बुध्दिनाथ झा	६/१०/२०७४	६/९/२०७४	डोटी वितरण केन्द्र	(१ ग्रेड)मिति२०७४/०८/२६को फैसलाले निर्णय बदर ।
२	नचछ ८२०६	ईन्जिनियर	७	श्री शत्रुधन यादव	६/१०/२०७४	६/९/२०७४	दुहवी वितरण केन्द्र	१ ग्रेड
३	ग ३७२२	ई.सि.	३	श्री शुरेश कुमार शिवाकोटी	९/१२/२०७४	८/३/२०७४	दमक वितरण केन्द्र	५ ग्रेड
४	धन ७३४०	सु भा.	५	श्री सुनिल ढकाल	१/६/२०७५	१२/२६/२०७४	विराटनगर वितरण केन्द्र	२ ग्रेड
५	दघ ६६६८	स.ले.पा.	४	श्री विजया पौडेल ढकाल	१/६/२०७५	१२/२५/२०७४	विराटनगर वितरण केन्द्र	२ ग्रेड
६	ग १३०११७	ड्राईभर	३	श्री देवेन्द्र वि.क.	२/९/२०७५	२/६/२०७५	तुलसीपुर वितरण केन्द्र	३ ग्रेड

ग्रेड घट्वा

क्र.सं.	क स.नं	पद	तह	नाम/थर	पत्रको मिति	निर्णय मिति	कार्यालय	कैफियत
१	नचछ ८२२९	ईन्जिनियर	७	श्री मुकुन्द राज पराजुली	१०/२६/२०७४	१०/१९/२०७४	ग्रीड विकास विभाग	५ ग्रेड

असाधारण विदा

क्र.सं.	क.स.नं.	पद	तह	नाम/थर	पत्रको मिति	निर्णय मिति	कार्यालय	कैफियत
१	ङप ८६८५	स.प्र.अ.	६	श्री शारदा मोहिनी डंगोल	५/१२/२०७४	५/७/२०७४	सूचना प्रविधि विभाग	
२	ङपफ ८६३५	प्र.अ.	७	श्री कमला श्रेष्ठ	७/१७/२०७४	७/१७/२०७४	आयोजना व्यवस्थापन नि.	५ महिना
३	खग २३९२	ई.सि.	३	श्री सागर शाक्य	९/३०/२०७४	९/२४/२०७४	लगनखेल वितरण केन्द्र	३ महिना
४	छजझत्र ११८३६	प्रवन्धक	१०	श्री अनिलमान श्रेष्ठ	१०/२/२०७४	१०/१/२०७५	कम्प्युटर वि.आयोजना	१ वर्ष
५	ङप ८८१७	स.प्र.अ.	६	श्री टिका प्रसाद बराल	१०/२४/२०७४	१०/२४/२०७४	दमक वितरण केन्द्र	२२ दिन
६	गध २६७०	फो.मे.	४	श्री उत्तम प्रसाद रिमाल	११/२३/२०७४	११/१४/२०७४	उत्पादन विकास विभाग	१२१ दिन
७	छज १७००७३	स. प्रवन्धक	८	श्री तेजकृष्ण श्रेष्ठ	११/२३/२०७४	११/१४/२०७४	विद्युत ब्यापार विभाग	२ महिना
८	कख १७१९	हेल्पर	२	श्री टंक प्रसाद पराजुली	१२/२६/२०७३	१२/२२/२०७३	जोरपाटी वितरण केन्द्र	५४ दिन
९	छजझ ११६९५	उप-प्रवन्धक	९	श्री शिव कुमार शाह	१२/२६/२०७४	१२/२२/२०७४	ईलेक्ट्रो मेकानिकल डि.	३२९ दिन
१०	घङप ३३८१	स.प्र.अ.	६	श्री दामोदर पोखरेल	१/१२/२०७५	१/९/२०७५	लगनखेल वितरण केन्द्र	१६० दिन
११	धन ७३४०	सु.भा.	५	श्री सुनिल कुमार ढकाल	२/१६/२०७५	२/१५/२०७५	विराटनगर वितरण केन्द्र	५२ दिन
१२	दघ ६६६८	स.ले पा.	४	श्री विजया पौडेल	२/१६/२०७५	२/१५/२०७५	विराटनगर वितरण केन्द्र	४७ दिन

असाधारण विदा रद्द

क्र.सं.	क.स.नं.	पद	तह	नाम/थर	पत्रको मिति	निर्णय मिति	कार्यालय	कैफियत
१	कख २०६५	हेल्पर	२	श्री नविनध्वज राणा	८/२०/२०७४	८/१८/२०७४	भक्तपुर वितरण केन्द्र	२५ दिन

पुनरावलोकन समितिको निर्णय

क्र.सं.	क.स.नं.	पद	तह	नाम/थर	लागुहुने मिति	निर्णय मिति	कार्यालय	कैफियत
१	छ १७००११	ईन्जिनियर	७	श्री बुध्दिनाथ झा	९/७/२०७४	८/२६/२०७४	डोटी वितरण केन्द्र	१ ग्रेड रोक्काको निर्णय बदर ।
२	नचछ ८२०६	ईन्जिनियर	७	श्री शत्रुधन यादव	९/२०/२०७४	९/१९/२०७४	दुहवी वितरण केन्द्र	१ ग्रेड रोक्काको निर्णय सदर।
३	नचछ ८२२९	ईन्जिनियर	७	श्री मुकुन्द राज पराजुली	२/७/२०७५	१/२६/२०७५	ग्रीड विकास विभाग	५ ग्रेड घट्वा गरिएकोमा २ ग्रेड मात्र घट्वा गर्ने निर्णय सदर।

थप आर्थिक सहायता

आ ब २०७४।०७५ मा थप आर्थिक सहायता लिने कर्मचारीहरुको विवरण ।

सि नं	पद	कर्मचारीको नामथर	कार्यरत कार्यालय	रोगको प्रकार
१	इ सि	प्रेमलाल श्रेष्ठ	महाराजगंज वितरण केन्द्र	ब्लड क्यान्सर
२	जु हे	रामकुमार लोप्चन	कंक्रिट पोल प्लान्ट	मुटु शल्यक्रिया
३	फोरमेन	भिमसेन खत्री	काभ्रे वितरण केन्द्र	मुटु शल्यक्रिया
४	मि रि सु भा	जयबहादुर खड्का	चमेलिया ज वि आयोजना	मुटु शल्यक्रिया
५	मि रि सु भा	लाल बहादुर गिरी	रत्नपार्क वितरण केन्द्र	मुटु शल्यक्रिया
६	सुपरभाइजर	कृष्णदेव प्रसाद साह	धादिङ वितरण केन्द्र	क्यान्सर
७	सुपरभाइजर	किशोर कुमार सुवेदी	कुलेखानी तेश्रो जलविद्युत आयोजना	क्यान्सर
८	सुपरभाइजर	नरेश झा	राजविराज वितरण केन्द्र	मृगौला
९	फोरमेन	दिवाकर थापा	कीर्तिपुर वितरण केन्द्र	मुटु शल्यक्रिया
१०	स प्रशासकीय अधिकृत	कैलाश बस्नेत	जोरपाटी वितरण केन्द्र	क्यान्सर

आ ब २०७४।०७५ आषाढ मसान्तसम्ममा आर्थिक सहायता अनुदान

सि न	विवरण	अनुदान लिने कर्मचारी संख्या	जम्मा रकम रु
१	काजक्रिया अनुदान	२८३ जना कर्मचारीको परिवारलाई १० हजारका दरले र ३१ जना कर्मचारी स्वयको मृत्यु भएकोले १५ हजारको दरले	३२९५०००
२	शैक्षिक अनुदान	२ जनालाई १० हजारका दरले	२००००
		जम्मा	३३१५०००

मिति २०७४ श्रावन १ गतेदेखि मिति २०७५ असार मसान्तसम्म कार्यालयको कामका सन्दर्भमा वा अन्य कारणले दुर्घटनामा परी मृत्यु तथा सामान्य दुर्घटनामा परी उपचार गराउने कर्मचारीहरूको विवरण

सि.नं	तह	क.स.नं	पद	कर्मचारीको नामथर	कार्यरत कार्यालय	दुर्घटना मिति	दुर्घटनाको कारण
१	१		ज्यालादारी	शम्भु महतो	सिमरा वितरण केन्द्र	२०७४।०४।०२	विद्युत दुर्घटनामा परि मृत्यु ।
२	४	ध,३३८३	फो.मे.	प्रकाश पौडेल	इंटहरि वितरण केन्द्र	२०७४।०४।०६	वितरण लाईन मर्मत गर्दा करेण्ट लागि मृत्यु भएको ।
३	१	कख ११८५	जु हेल्पर	गोपीकृष्ण पौडेल	पाल्पा वितरण केन्द्र	२०७४।०४।२४	एल.टि लाईन कार्य गर्दा पोलबाट भुईमा खसेको ।
४	२	थ,३२००३	कार्यालय सहयोगि	निर्मल कार्की	सिन्धुपाल्चोक वितरण केन्द्र ।	२०७४।०४।२७	कार्यालयको कामको सिलसिलामा फलामको च्यानलले टाउकामा लागि दुर्घटना भएको ।
५	३	खग२२९०	इसी	चुडामणि भट्ट	प्युठान वितरण केन्द्र	२०७४।०९।२२	मोटर साईकल दुर्घटना ।
७	४	ध,७५२४	फो.मे.	दिपक कुमार राजवंशी	कुलेखानी दोश्रो ज.वि. केन्द्र	२०७४।०९।२२	पावर हाउसको डेन पम्प मर्मत गर्दा दुर्घटनामा परि बाँया हातको माझी औंला काटिएको ।
८	३	ग५०८६	इसी	पदम बहादुर पुन	पोखरा वितरण केन्द्र	२०७४।०९।२२	विद्युत दुर्घटना ।
९	३	कखग८०४	इ सी	विश्वोमित्र ढकाल	मध्य मर्स्याङ्दी ज वि केन्द्र	२०७४।०९।२२	विद्युत दुर्घटना ।
१०	४	घ३४०६०९	सिमिरी	सुनिल कुमार कर्ण	डडेल्धुरा वितरण केन्द्र	२०७४।०९।२७	विद्युत दुर्घटना ।
११	२	कख२०७०	हेल्पर	मान बहादुर गबल	सुर्खेत वितरण केन्द्र	२०७४।१२।१२	विद्युत दुर्घटना बायाँ हात काटिएको
१२	३	कखग६८	इसी	महेन्द्र राउत सुडी	जनकपुर वितरण केन्द्र	२०७४।१२।२१	विद्युत दुर्घटना दायाँ हात काटिएको
१३	३	खग२२४१	इसी	इन्द्र राज चौधरी	परासी वितरण केन्द्र	२०७४।१२।१४	विद्युत दुर्घटनामा परि मृत्यु ।
१४	४	ध,१३८६	फोरमेन	सुन्दरलाल चौधरी	धनगढि वितरण केन्द्र	२०७५।०१।१८	विद्युत दुर्घटना
१५	३	ग, ३५१८	ई.सि.	दिनेश दंगाल	इटहरी वितरण केन्द्र	२०७५।०१।१३	विद्युत दुर्घटना।
१६	३	ग,३७१७	इ.सी	जिवन दवाढी	अनारमनी वितरण केन्द्र	२०७५।०१।०३	विद्युत दुर्घटना
१७	४	ध,१८०५	सु.भा	शंकर प्रसाद पोखरेल	काठमाण्डौ ग्रिड महाशाखा	२०७४/०१/२७	विद्युत दुर्घटना
१९	५ २	ड,२५०१७२ तथ४८४१	ले.पा. का स	सीता कोइराला ठगवा चौधरी	परासी वितरण केन्द्र कोहलपुर वितरण केन्द्र	२०७५/०१/२८ २०७५/०१/२८	सवारीसाधन दुर्घटना विद्युत दुर्घटनामा परि उपचारको क्रममा मृत्यु
२०	२	कख११०३६४	हेल्पर	अजिर धुनिया	परासी वितरण केन्द्र	२०७५/२/११	विद्युत दुर्घटना
२१	२	क१९७८	जे.हे	नवराज राजवंशी	लगनखेल वितरण केन्द्र	२०७४/११/२३	दुर्घटना
२२	३	कख१५१	इ.सी	बाबुराम अधिकारी	ठिमी वितरण केन्द्र	२०७४/१२/२४	दुर्घटना
२३	५	गधन३१७४	सु.भा	सन्तोष ढकाल	बेलबारी वितरण केन्द्र	२०७४/११/८	दुर्घटना
२४	२	तथ५४०३	का स	मिना कुमारी मेस्तर	विरगंज वितरण केन्द्र	२०७४/१२/१२	दुर्घटना
२५	४	घ१४०११९	फोरमेन	कृष्ण विहारी सिंह	इलाम पुवाखोला ज.वि केन्द्र	२०७४/६/२६	दुर्घटना
२६	२	कख२०३४	हेल्पर	गौतम थापा	पोखरा वितरण केन्द्र	२०७५/०३/३०	विद्युत दुर्घटना

नेपाल विद्युत प्राधिकरण

कर्मचारी कल्याण महाशाखा

आ.व. २०७४/७५ सावधिक जीवन बीमाको वार्षिक गतिविधि विवरण

१)	जीवन बीमा योजनाको शुरुदेखि हालसम्म बीमा संस्थानमा प्रिमियमबपत बुझाइएको कुल रकम:	४,९२,९३,५५,७४१/३६
२)	२०१७/११/२३ को बीमा नविकरणमा (मिति २०७४/८/७ देखि २०७५/८/६ सम्मका लागि) ५७७८ जनाको बीमा शुल्क बुझाएको रकम:	३८,६४,४९,५४९/८३
३)	आ.व. ०७४/०७५ मा जीवन बीमा वापत बीमा संस्थानवाट प्राप्त हुन आएको रकम:	४८,६६,५१,७०७/८०
	क) २०१७ मा अवधि समाप्त भई प्राप्त भएको ५०३ जनाको रकम	४६,२८,६०,६३८/००
	ख) समर्पण र मृत्यू दावी वाट प्राप्त भएको ३८ जनाको रकम	२,३७,९१,०६९/८०
	जम्मा:	४८,६६,५१,७०७/८०
४)	आ.व.०७४/७५ मा निम्न विवरण अनुसार ८७७ जना कर्मचारीहरुलाई जीवन बीमा वापत भूक्तानी भएको रकम:	७०,६०,७८,१०७/७२

अवकाशको विवरण	संख्या	वीमावाट प्राप्त	ने.वि.प्रा.वाट थप	जम्मा
राजीनामा	३६	५०,७५,३२९/६९	१,०२,६३,२९१/९०	१,५३,३८,६२१/५९
स्वैच्छिक अवकाश	५६	६०,२४,२१७/३४	३,५५,४४,१०२/००	४,१५,६८,३१९/३४
स्वत:अवकाश	३	६,१२,२८५/०६	५,१०,०८४/००	११,२२,३६९/०६
म्याच्यूरिटी भूक्तानी	४५०	४१,९९,०२,२८२/१९	०	४१,९९,०२,२८२/१९
बर्खास्त	७	५,२४,९०७/५९	०	५,२४,९०७/५९
अनिवार्य अवकाश	२९२	१,७७,६६,०८२/१५	१८,२२,५४,७१५/००	२०,००,२०,७९७/१५
मृत्यू	३३	१,७५,३६,२७८/८०	१,००,६४,५३२/००	२,७६,००,८१०/८०
जम्मा	८७७	४६,७४,४१,३८२/८२	२३,८६,३६,७२४/९०	७०,६०,७८,१०७/७२

नेपाल विद्युत प्राधिकरण
प्रशासन निर्देशनालय
जनसाधन विभाग
केन्द्रीय कर्मचारी प्रशासन शाखा
२०७५ असार मसान्त

पद	सेवा	स्वीकृत दरबन्दी			मौजुदा कर्मचारी			
		नियमित	आयोजना	जम्मा	स्थायी	म्यादीमा कार्यरत कर्मचारी संख्या	करार/ ज्यालादारीमा कार्यरत कर्मचारी संख्या	जम्मा
उप कार्यकारी निर्देशक	(प्राविधिक/प्रशासन)	९	०	९	९	०		९
अधिकृत स्तर (तह ६ देखि ११सम्म)	प्राविधिक	१२४८	११३	१३६१	११५१	०	१	११५२
	प्रशासन	५८२	२३	६०५	५५९	१	०	५६०
	जम्मा	१८३०	१३६	१९६६	१७१०	१	१	१७१२
सहायक स्तर (तह १ देखि ५सम्म)	प्राविधिक	५८८३	०	५८८३	४५९१	२२	४७	४६६०
	प्रशासन	३२८४	०	३२८४	२७११	१२	२१	२७४४
	जम्मा	९१६७	०	९१६७	७३०२	३४	६८	७४०४
	कुल जम्मा	११००६	१३६	१११४२	९०२१	३५	६९	९१२५

चपली सब स्टेशन

मध्यमर्स्याङ्दी हाइड्रोपावर

स्याउले सबस्टेशन ।

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दरबारमार्ग, काठमाडौं
फोन. ४१५३०२१, आन्तरिक : २००२, २००३, फ्याक्स : ४१५३०२२
pro@nea.org.np