Task 6 – Monitoring and Evaluation

Detailed Feasibility Studies: Transmission Projects in Nepal

Volume 6 (Report)

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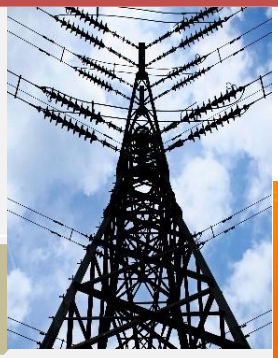

TETRA TECH

Detailed Feasibility Study:
Nepal Priority Transmission Projects

Volume 6 Report
Task 6: Monitoring and Evaluation

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Acronyms

ADB	Asian Development Bank
GIS	Gas-insulated switchgear or geographic information system
GOD	Grid Operation Department of NEA
IEE	Initial Environmental Examination
ITT	Indicator tracking table
MCC	Millennium Challenge Corporation
M&D	Monitoring and evaluation
MIS	Management information system
MVA	Mega-volt ampere
NEA	Nepal Electricity Authority
OMCN	Office of Millennium Challenge/Nepal
PI	Performance indicator
PMC	Project Management Consultant
RTU	Remote telemetry units
SAIDI	System Average Interruption Duration Index
SAIFI	Average interruption frequency per year
SCADA	Supervisory control and data acquisition
WB	World Bank

Executive Summary

The Millennium Challenge Corporation's (MCC) proposed power transmission project must be implemented within a five-year timeframe and will cover about 600 km of 400 kV and 220 kV transmission lines, and 14 associated substations. The project will include the first gas-insulated switchgear (GIS) substation and first 400 kV transmission network in Nepal. It is anticipated that MCC's compact will produce a five-fold increase in cross-border electricity trade with India, increase per capita electricity consumption, and accelerate economic and social development in Nepal.

An effective monitoring and evaluation (M&E) framework is needed to measure the compact's progress/process, outputs and outcomes in an objective fashion. To meet this requirement, we have recommended 33 performance indicators (PIs): 18 process indicators, 7 output indicators, and 8 outcome indicators. Outcome indicators were developed primarily to measure the post-implementation impacts of the transmission system. The recommended PIs are based on the M&E framework used by Nepal Electricity Authority, Asian Development Bank, and World Bank for their transmission projects, the guidance provided in MCC's Common Power Indicators document, and the discussions that have taken place with MCC, Office of Millennium Challenge/Nepal, and other stakeholders.

The M&E framework provides details on the data needed to measure the 2 PIs, and how data will flow to help calculate/determine the PIs. Efforts have been made to collect most of the data needed from MCA office software and the SCADA (supervisory control and data acquisition) of the Load Dispatch Center without human interference. However, some site-specific data will be collected manually from project sites and will be entered into the management information system (MIS) through a web-based window.

This report also provides details on measuring and reporting the 33 PIs. Monthly, quarterly, bi-annual and annual reporting is recommended, depending on the frequency of the measurement of the PIs. In addition, two full-time resources are recommended for the development and operation of the suggested M&E framework. The total estimated cost, including the cost of these two resources and development of specific MIS software, is USD 684,306.

1. Introduction

Monitoring and evaluation (M&E) serves as a guide for project implementation and management by supporting an understanding of the progress made towards the achievement of objectives and results. It identifies the variance between targets and actual achievements during implementation. Therefore, we sought to develop and recommend performance indicators (PIs) that can serve as a basis for tracking the progress of activities (e.g., construction) and the achievement of results (e.g., decreased outages or increased availability of power) for this compact. The PIs were developed based on the objectives of the compact, anticipated challenges in its implementation, and MCC's Power Common Indicators.

We have suggested a holistic and robust M&E framework for this MCC compact. It consists of performance indicators, data flows for the determination of PIs, measurement of PIs, reporting of PIs, and resources required for the implementation of this M&E framework. The performance indicators recommended are measurable and reliable, and provide an accurate representation of the project conditions and actions. Other considerations made for PI development were ease and accuracy of measurability.

In developing the M&E framework, we have studied the existing M&E frameworks for the transmission projects of the Nepal Electricity Authority's (NEA), Asian Development Bank (ADB), and World Bank, and the Common Power Indicators of MCC. Information was collected from these sources through desk research and discussions with NEA, ADB, World Bank, Office of Millennium Challenge/Nepal (OMCN), MCC and other stakeholders. While developing the performance indicators, we also considered the compact's objectives and the anticipated challenges and risks in implementing this compact.

Section 2 of this report reviews the M&E framework used by NEA, ADB and World Bank for transmission projects; it also provides an understanding of the MCC Common Power Indicators for transmission projects. Section 3 provides details for the PIs recommended for this compact, Section 4 is describes the data collection efforts, Section 5 addresses measurement and reporting, and Section 6 describes resource requirements.

2. Review of M&E Frameworks for Transmission Projects in Nepal

Most transmission projects in Nepal are executed by NEA, ADB and the World Bank. Their M&E frameworks, including performance indicators, data collection, measurement methodology and reporting mechanisms are summarized in this section. They are analyzed here against the MCC Common Power Indicators by: 1) process Indicators, to track the project' implementation progress, 2) output indicators, to track whether or not the project is delivering the desired outputs, and 3) outcome indicators, to track that whether or not the project is producing the desired impacts.

2.1 Nepal Electricity Authority

NEA's monitoring and evaluation of the transmission sector is implemented by two entities within the transmission directorate of NEA:

- Grid Operation Department: collects data and prepares M&E reports on existing transmission lines and substations
- Monitoring and MIS Section under NEA's Transmission Directorate: collects data and prepares M&E reports on transmission lines and substations under various phases of development/construction.

2.1.1 Grid Operation Department

The Grid Operation Department (GOD) produces the following "Energy Transaction Reports":

1. Monthly Energy Report of Substations
2. Monthly Outage Report
3. Monthly Power Transformer Loading Report
4. Monthly Voltage Variation Report
5. Weekly Report on Loading Status, Tripping and Planned Outages.

Annex A provides samples of these reports for Ashadh 2073 (15 June to 15 July 2016). These reports measure transmission system parameters such as loads, outages, voltages, and energy flows. Data for the reports are collected manually (generally in hard copy and CDs) from log sheets and are recorded in Excel files by the branches/divisions of GOD. Substation data are collected by GOD branches/divisions.

GOD has only two staff members on its M&E team. One is responsible for collecting data from the branches/divisions, while the other converts the data into Excel reports. The reports are circulated to the Ministry of Energy and NEA's Finance Department.

2.1.2 Monitoring and MIS Section

One of the eight departments in NEA's Transmission Directorate is devoted to M&E, reflecting the importance the Authority places on monitoring. This department generates monthly, quarterly, and annual reports. The monthly reports provide details on the activities carried out during the month against the plan for each project. Annex B[1] provides a sample of a typical monthly report for the Kabele corridor 132 kV transmission line project.

The more detailed quarterly reports monitor the following parameters to determine: 1) the percentage of expenses against the quarterly/annual budgets, 2) total expenses to date, 3) the percentage of time elapsed, and 4) physical progress in percentages:

1. Program capital expenditures
2. Substation construction
3. Transportation
4. Other activities (consultancy services, social responsibilities, and rural electrification)
5. Environmental studies (terms of reference, initial environmental examination (IEE) draft, IEE approval, etc.)
6. Availability of land/right of way compensation/agricultural crop compensation.

The status of these six parameters is determined by measuring several sub-parameters. A typical sample quarterly report is contained in Annex C (also for the Kabele corridor), while a sample annual report can be found in Annex D. The formats for the monthly and annual reports are the same, and were developed by the National Planning Commission of Nepal for NEA's Transmission Directorate. In addition, the Ministry of Energy prepares a trimester report that tracks physical and financial progress, milestones achieved, and problems faced, while making recommendations for the problems' resolution (see Annex E).

Package managers are responsible for providing the data for these reports to the MIS Section in Excel format. The MIS Section then reviews the information collected from each project package, and consolidates and processes it. The Section then submits the reports to the National Planning Commission, Ministry of Energy and other NEA departments.

The MIS Section has only one staff member. A few years' ago, NEA procured locally-developed management information system software. However, it is not used because the software was not user friendly, staff lacked computer literacy, there were few efforts to build its capacity in this regard, and a general lack of willingness to adopt new practices.

The NEA faces several main challenges in its M&E activities:

- Delays in report generation due to the manual collection of data.
- The field units' use of different formats in transmitting data.
- Lack of capacity building at all levels.
- Need for additional staff in the MIS Section.

[1] The reports in Annexes B through 6-E were translated from Nepali; Tetra Tech takes no responsibility for the accuracy of the translation.

- Absence of graphs in the reports.
- Targets and delays are not properly highlighted in the reports
- Reporting is not based on gender and other socio-economic parameters.

2.2 World Bank

Table 1 presents the World Bank indicators, which were identified from Bank-funded power transmission projects in Nepal (by discussion) and some of the transmission projects sponsored by the World Bank (WB) in other countries such as China and Zambia. These projects were also linked with other activities, such as institutional reform and distribution sector reform. We have also observed that performance indicators, particularly outcome indicators, depend largely on project objectives.

Table 1. World Bank Indicators

Process Indicators	Output Indicators	Outcome Indicators
▪ Transmission line upgraded or built ▪ Transmission substation capacity added ▪ Increase in power transfer capacity	▪ Average interruption frequency per year (SAIFI) ▪ Direct project beneficiaries, male (Number) ▪ Direct project beneficiaries, female (Numbers) ▪ Employment generation during construction phase	▪ Avoidance of load shedding. ▪ New methodology and software for planning/grid operation and maintenance ▪ Competition in generation sector

2.3 Asian Development Bank

Table 2 shows the indicators employed by the Asian Development Bank. These indicators have been identified from ADB's *Manual for Calculating Energy Output Indicators* and from discussions on ADB-funded power transmission projects in Nepal, the Philippines, Cambodia and Azerbaijan. We have also observed that performance indicators, particularly outcome indicators, depend largely on project objectives. ADB normally uses following five indicators to review infrastructure projects with equal 20% weightage to each:-

- Contract award according to schedule
- Disbursement of fund
- Financial management / audit
- Technical issue
- Safeguard

Under safeguard, there are following three sub categories to monitor specifically environmental and social aspects of the project:-

- EMP (Environment Management Practice),
- Resettlement Plan and
- Indigenous people plan.

Projects are reviewed quarterly on the basis of above. If the project score less than 70% it is considered in red zone, (not satisfactory); above 70-90% yellow, (good progress) and above 90% green, (excellent).

However, the energy indicators are generally classified under three other categories: 1) Promoting Energy Efficiency and Renewable Energy, 2) Maximizing Access to Energy for All, and 3) Promoting Energy Sector Reform, Capacity Building and Governance.

For ease of comparison, we have classified indicators relevant for this Compact, under MCC Guidance on Common Indicator (Process, Output and Outcome).

Table 2. Asian Development Bank

Process Indicators	Output Indicators	Outcome Indicators
▪ Transmission line upgraded or built ▪ Transmission substation capacity added ▪ Increase in power transfer capacity ▪ Funds disbursement ▪ Contract award	▪ Average interruption frequency per year (SAIFI) ▪ Reduction in overloading of the transmission lines ▪ Increase in rural electrification ▪ Recommended social and environmental mitigation measures ▪ Number of training programs ▪ Local complaints about compensation	▪ Increase in the supply of electricity ▪ Increase in power generation ▪ Annual net CO_2 emission reductions ▪ Impact on local people

2.4 Millennium Challenge Corporation

Table 3 lists the relevant indicators for the monitoring and evaluation of power transmission projects, as suggested in MCC's *Guidance on Common Indicators*.[2]

Table 3. MCC: Common Indicators for Power

Process Indicators	Output Indicators	Outcome Indicators
[P-1] Value of signed infrastructure feasibility and design contracts [P-2] Present disbursement of power infrastructure feasibility and design contracts [P-3] Value of signed power infrastructure construction contracts [P-4] Present disbursement of power infrastructure construction contracts [P-5] Temporary employment generated by power infrastructure construction	[P-7] Transmission line upgraded or built [P-8] Transmission throughput capacity added [P-9] Transmission substation capacity added	[P-18] Transmission system technical losses (%)

The standard MCC procedure for M&E uses an indicator tracking table (ITT). The ITT is formulated using MCC's "Guidance on the Indicator Tracking Table" in its general implementation guidelines. The ITT consists of various indicators that are used to track the progress of a project. The ITT is an Excel-based model that can be also created in a management information system (MIS). MCA has the responsibility of preparing the ITT and submitting it to MCC each quarter. The MIS software recommended here for development will have that feature.

[2] https://www.mcc.gov/resources/doc/guidance-on-common-indicators

3. Recommendations for Performance Indicators

This section provides our recommendations for the performance indicators. In order to maintain continuity, we propose to follow the same classification and numbering of indicators as provided in MCC's Common Power Indicator document. We do not propose any changes to the transmission indicators provided in that document. However, in order to address the specific objectives and challenges of this compact, we propose to add a few more indicators. They are numbered A-1, A-2, etc. in Table 4. Further, we feel while MCC and MCA will like to monitor the progress at the compact level, MCA package managers will want to monitor the project's progress at the package level, and on a more granular level, as depicted in Figure 1. We have suggested indicators specific to their requirements, which are designated P-1.1, P2.1, A-1.1, etc. in the exhibits that follow.

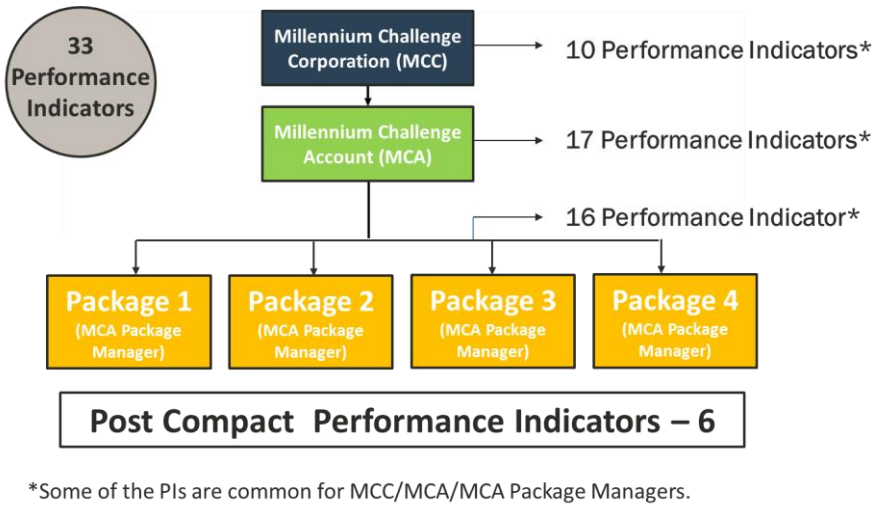


Figure 1. M&E Framework Hierarchy

Once the proposed transmission line is functional, we suggest post-compact indicators from PC-1 to PC-6 to evaluate the impact/success of the compact. We understand that one of the compact's conditions is that during the post-compact period, the host country would measure and report to MCC on the performance indicators identified by MCC. Our complete recommendation for the performance indicators are presented in Table 4.

Table 4. Recommended Performance Indicators

Process Indicators	Output Indicators	Outcome Indicators
[P-1] Value of signed infrastructure feasibility and design contracts (for compact) [P-1.1] Value of signed infrastructure feasibility and design contracts (for project package)	[P-7] Transmission line upgraded or built (for compact) [P-7.1] Transmission line upgraded or built (for project package)	[P-18] Transmission system technical losses (%) [A-6] Number of capacity building programs disaggregated based on sex.

Table 4. Recommended Performance Indicators

Process Indicators	Output Indicators	Outcome Indicators
[P-2] Present disbursement of power infrastructure feasibility and design contracts (for compact) [P-2.1] Present disbursement of power infrastructure feasibility and design contracts (for project package) [P-3] Value of signed power infrastructure construction contracts [P-4] Present disbursement of power infrastructure construction contracts [P-5] Temporary employment generated by power infrastructure construction disaggregated based on sex. [A-1] Percent completion of Environmental and Social Management Systems [A-2] Number of environmental or social problems associated with the project reported and not yet resolved (for compact) [A-2.1] Number of environmental or social problems associated with the project reported and not yet resolved (for project package) [A-3] Number of land transfers effected [A-3.1] Number of land transfers effected (for project package) [P-7.2] Number of tower foundations constructed (for project package) [P-7.3] Number of towers constructed (for project package) [P-9.1] Transformers available at package (for project package) [P-9.2] Transformers available at package (for project package) [P-9.3] Breakers and Isolators available at package (for project package) [P-9.4] Switchgear panels available at package (for project package)	[P-8] Transmission throughput capacity added [P-9] Transmission substation capacity added [A-4] No. of transmission substations rehabilitated [A-5] Area of land acquired [A-7] Capacity Utilization Factor of a transmission line	[PC-1] Increase in Energy Consumed per Unit of Capita [PC-2] Alleviation of Electricity Shortage (load shedding) [PC-3] Change in System Average Interruption Duration Index (SAIDI) [PC-4] Change in System Average Interruption Frequency Index (SAIFI) [PC-5] Percent Households Electrified [PC-6] Increase in power flow (import and export) from neighboring countries.

Our recommendations for the use of performance indicators (PI) by MCC, MCA and MCA package managers and their frequency of measurement are provided in Table 5. In the table we have indicated their importance by classifying them under high, medium and low categories:

Table 5. Importance of Performance Indicators

0	PI Number	Performance Indicator	Indicator Type	Importance	MCA Package Manager	MCA	MCC	Frequency
1	P-1	Value of signed infrastructure feasibility and design contracts (for compact)	Process	High		√	√	Monthly
2	P-1.1	Value of signed infrastructure feasibility and design contracts (for project package)	Process	High	√			Monthly
3	P-2	Present disbursement of power infrastructure feasibility and design contracts (for compact)	Process	High		√	√	Monthly
4	P-2.1	Present disbursement of power infrastructure feasibility and design contracts (for project packages)	Process	High	√			Monthly
5	P-3	Value of signed power infrastructure construction contracts	Process	Low		√	√	Quarterly
6	P-4	Present disbursement of power infrastructure construction contracts	Process	Low		√	√	Quarterly
7	P-5	Temporary employment generated by power infrastructure construction disaggregated based on sex	Process	Medium		√	√	Quarterly
8	A-1	Percent completion of Environmental and Social Management Systems	Process	High		√		Monthly
9	A-2	Number of environmental or social problems associated with the project reported and not yet resolved (for compact)	Process	Medium		√		Monthly

Table 5. Importance of Performance Indicators

0	PI Number	Performance Indicator	Indicator Type	Importance	MCA Package Manager	MCA	MCC	Frequency
10	A.2.1	Number of environmental or social problems associated with the project reported and not yet resolved (for a package)	Process	Medium		√		Monthly
11	A-3	Number of land transfers effected (for compact)	Process	High		√		Monthly
12	A-3.1	Number of land transfers effected (for project package)	Process	High	√			Monthly
13	P-7	Transmission line upgraded or built (for compact)	Output	High		√	√	Monthly
14	P-7.1	Transmission line upgraded or built (for a Package)	Output	High		√		Monthly
15	P-7.2	Number of tower foundations constructed	Process	Low	√			Monthly
16	P-7.3	Number of towers constructed	Process	Low	√			Monthly
17	P-8	Transmission throughput capacity added	Output	High		√	√	Quarterly
18	P-9	Transmission substation capacity added	Output	Low		√	√	Quarterly
19	P-9.1	Length of entry road constructed	Process	Medium	√			Quarterly
20	P-9.2	Transformers available at package	Process	Medium	√			Quarterly
21	P-9.3	Breakers and isolators available at package	Process	Medium	√			Quarterly
22	P-9.4	Switchgear panels available at package	Process	Medium	√			Quarterly
23	A-4	No. of transmission substations upgraded	Output	High		√		Quarterly
24	A-5	Area of land acquired	Output	High		√		Monthly
25	P-18	Transmission system technical losses (%)	Outcome	High		√	√	Rolling quarterly
26	A-6	Number of capacity building programs, disaggregated based on sex	Outcome	Medium		√		Quarterly

Table 5. Importance of Performance Indicators

0	PI Number	Performance Indicator	Indicator Type	Importance	MCA Package Manager	MCA	MCC	Frequency
27	[A-7]	Capacity Utilization Factor of a transmission line	Output	Medium		√	√	Quarterly
28	[PC-1]	Increase in energy consumed per unit of capita	Outcome	High			√	Yearly
29	[PC-2]	Alleviation of electricity shortage (load shedding)	Outcome	High			√	Yearly
30	[PC-3]	Change in system average interruption duration index (SAIDI)	Outcome	High			√	Quarterly
31	[PC-4]	Change in system average interruption frequency index (SAIFI)	Outcome	Medium			√	Quarterly
32	[PC-5]	Percent households electrified	Outcome	High			√	Yearly
33	[PC-6]	Increase in power flow (import and export) from neighboring countries	Outcome	High			√	Yearly

Next, we describe each of the above 33 recommended PIs in the format specified in MCC's Guidance on Common Indicators. We have added a few additional fields: data required, data source, data quality, baseline, interim target and reporting frequency to the MCC template for completeness. Data required specifies the data needed to determine that PI, data source specifies from where these data will come from, and data quality has been categorized under reliable (data coming from the system is classified as reliable) and dependable (data coming by manual intervention are generally classified as dependable). In many places for data source, we have mentioned the MCA system. Here we have assumed in MCA there will be some computerized system where all contracts, payments, etc. will be entered and this will be installed as part of the MCA office's establishment. For the indicators from MCC Common Indicator document units, definition, guidance, level, classification and disaggregation are repeated from the MCC document.

[P-1] Value of Signed Infrastructure Feasibility and Design Contracts (for Compact)

Unit: US Dollars

Definition: The value of all signed feasibility, design, and environmental impact assessment contracts, including resettlement action plans, for power infrastructure investments using 609(g) and compact funds.

Guidance: The target for this indicator should be the original value of the contract when first signed. If the value of a contract changes, the contract modification amount should be reported in the indicator tracking table (ITT) in the quarter when the change occurred. The "Actual to Date" should reflect the current contract value, including all modifications. Costs associated with pre-feasibility studies (if done by MCC) should not be included, nor should the cost of supervision and project management.

Level: Process indicator.

Classification: Cumulative.
Disaggregation: Based on packages
Data Required: Original value of the contract and any contract modification; it includes all costs.
Data Source: The value for the required data will be taken from the MCA system or from the contract document.
Data Quality: Reliable
Baseline and Target: Baseline = 0, Target = Budget for Signed Infrastructure Feasibility and Design Contracts (X).
Interim Target:

Year 1:	50% of X	Year 2:	80% of X	Year 3:	90% of X	Year 4:	100% of X	Year 5:	100% of X

Reporting Frequency: Monthly.

[P-1.1] Value of Signed Infrastructure Feasibility and Design Contracts (for project package)

This indicator is the same as [P-1], but will be measured for the specific project package.

[P-2] Present Disbursement of Power Infrastructure Feasibility and Design Contracts (for Compact)

Unit: Percentage.
Definition: The total amount of all signed feasibility, design, and environmental impact assessment contracts, including resettlement action plans, for power infrastructure disbursed divided by the total current value of signed contracts.
Guidance: Numerator = value disbursed of power infrastructure feasibility and design contracts. Value disbursed should be defined as: the amount disbursed of all signed feasibility, design, and environmental impact assessment contracts, including resettlement action plans, for power infrastructure using 609(g) and compact funds. Denominator = value of signed power infrastructure feasibility and design contracts.
Level: Process indicator.
Classification: Level.
Disaggregation: Based on project package.
Data Required: Payment/disbursement made against all contracts.
Data Source: The value for the required data will be taken from MCA from the contract document.
Data Quality: Reliable
Baseline and Target: Baseline = 0%, Target = 100%.
Interim Target:

Year 1:	20%	Year 2:	40%	Year 3:	80%	Year 4:	90%	Year 5:	100%

Reporting Frequency: Monthly

[P-2.1] Present Disbursement of Power Infrastructure Feasibility and Design Contracts (for project package)

This indicator is the same as [P-2], but will be measured for the specific project package.

[P-3] Value of Signed Power Infrastructure Construction Contracts

Unit: US Dollars.
Definition: The value of all signed construction contracts for power infrastructure investments using compact funds.

Guidance: The target for this indicator should be the original value of the contract when first signed. If the value of a contract changes, the contract modification amount should be reported in the ITT in the quarter in which the change occurred. Cost sharing by others (e.g., the non-MCC funding component of any co-financing with other donors or governments) should not be included. However, costs associated with supervision or project management should be included.
Level: Process indicator.
Classification: Cumulative.
Disaggregation: Based on packages
Data Required: Original value of the contract, contract modification amount, and cost associated with construction contract.
Data Source: The value for the required data will be taken from MCA from the contract document and modified contract document, if any, for all construction contracts.
Data Quality: Reliable.
Baseline and Target: Baseline = 0%, Target = value of signed power infrastructure construction contracts (A).
Interim Target:

Year 1:	20% of A	Year 2:	40% of A	Year 3:	80% of A	Year 4:	90% of A	Year 5:	100% of A

Reporting Frequency: Quarterly.

[P-4] Percentage Disbursement of Power Infrastructure Construction Contracts

Unit: Percentage.
Definition: The total amount of all signed construction contracts for power infrastructure investments disbursed divided by the total current value of all signed contracts.
Guidance: Numerator= value disbursed of power infrastructure construction contracts. Value disbursed should be defined as: the amount disbursed of all signed construction contracts for power infrastructure investments using compact funds. Denominator = value of signed power infrastructure construction contracts.
Level: Process indicator.
Classification: Level.
Disaggregation: Based on packages
Data Required: Amount disbursed of all signed construction contracts for power infrastructure using compact funds and total value of all the signed construction contracts.
Data Source: The value for the required data will be taken from MCA system. The payment made for construction contracts against the total value of the signed construction contracts.
Data Quality: Reliable.
Baseline and Target: Baseline = 0%, Target = 100%.
Interim Target:

Year 1:	20%	Year 2:	40%	Year 3:	80%	Year 4:	90%	Year 5:	100%

Reporting Frequency: Quarterly.

[P-5] Temporary Employment Generated by Power Infrastructure Construction

Unit: Number.
Definition: The number of people temporarily employed or contracted by MCA-contracted construction companies to work on the construction of new power infrastructure or reconstruction, rehabilitation, or upgrading of existing power infrastructure.

Guidance: This indicator counts the unique number of people contracted, not the amount of time that those people were temporarily employed. Even if a person was contracted for 1 day, he/she should be counted. Both local and foreign workers should be included but identified separately. Foreign workers are any workers who require a resident permit to work in the country; anyone considered a national in the country should be counted as a local worker. Those performing labor that requires specialized training or a learned skill-sets to perform the work should be counted as skilled workers. Those performing labor that requires some skill that may not be performed by an unskilled worker, but does not require highly specialized skills, should be counted as semi-skilled workers. Those performing labor that does not require special training or skills should be counted as unskilled workers. Informal employment generated by construction activities is not included. However, if an individual worked on the project in one quarter, stopped working, and rejoined later, s/he should only be counted once. Therefore, tracking this indicator requires a process for uniquely identifying workers, which should be required in the scope of work for relevant contractors.
Level: Process indicator.
Classification: Cumulative.
Disaggregation: Male/female, foreign/local, skilled/semi-skilled/unskilled, poverty level[3].
Data Required: No. of people contracted, gender of the worker, no. of skilled workers contracted, no. of foreign workers contracted.
Data Source: The required data will be collected from the contractors who have been assigned to implement the project. A segregation will be needed between skilled-unskilled and national-international manpower engaged in the execution of the project.
Data Quality: Dependable.
Baseline and Target: Baseline= 0, Target = to be decided in discussions with construction contractors.
Interim Target: To be decided in discussions with construction contractors.
Reporting Frequency: Quarterly.

[A-1] Percent Completion of Environmental and Social Management Systems (ESMS)

Unit: Percent.
Definition: Completion of environmental and social management system, including health and safety issues vs. total completion.
Guidance: An environmental and social management system consists of several activities. Each activity will be assigned a weight depending upon its importance. The percentage completion will be determined on the basis of the weighted average of the number of activities completed. A partially completed activity will be counted as incomplete. The summation of all the activities completed multiplied by their weights, divided by sum of total activities, and multiplied by their weights.
Level: Process indicator.
Classification: Cumulative.
Disaggregation: Based on packages.
Data Required: List of activities in the ESMS with the importance and status of each activity.
Data Source: ESMS Consultant/Manger, Monthly progress reports and MCA package manager
Data Quality: Dependable.

[3] As per the national living standards survey conducted in 2010-2011, a family is considered to be below poverty level if earning is less than US$14 in a month. https://www.ruralpovertyportal.org/country/home/tags/nepal

Baseline and Target: Baseline = 0, Target = 100%.
Interim Target: The activity is proposed to be completed before the compact comes into force.
Reporting Frequency: Monthly.

[A-2] Number of Environmental, Social or Resettlement Problems Associated with the Project Reported and Not Yet Resolved (for Compact)

Unit: Number
Definition: Percentage of the total number of environmental, social or resettlement problems associated with the project reported and not yet resolved. The percentage of number of problems unresolved divided by the total number of environmental, social or resettlement problems associated with the project that are reported.
Guidance: This will help to determine the effectiveness of the grievance/problem resolution mechanism for environmental, social or resettlement problems. The mechanism is described in Task 3 report for resettlement issues. The mechanism for environment and social issues will be covered in ESIA and ESMP. This percentage should come down and ideally become zero before the start of package activities.
Level: Process indicator.
Classification: Cumulative.
Disaggregation: Based on packages.
Data Required: Total problems received and the number of problems unresolved for environment, social and for resettlement issues.
Data Source: Engineer and/or from MCA package manger.
Data Quality: Dependable.
Baseline and Target: Baseline= The number of complaints received not resolved within 45 days (45 days are here for illustration. Actual value should be fixed based on ground conditions), Target = 0.
Interim Target:

Year 1:	0	Year 2:	0	Year 3:	0	Year 4:	0	Year 5:	0

Reporting Frequency: Monthly.

[A-2.1] Number of Environmental, Social or Resettlement Problems Associated with the Project Reported and Not Yet Resolved (for a package)

This indicator is same as [A-2], but will be measured for specific project package by the MCA package manager.

[A-3] Number of Land Transfers Effected (for Compact)

Unit: Number
Definition: The total current number of acquisitions for the project divided by the total number of land parcels to be acquired.
Guidance: Several parcels of land are to be acquired for the project; their deeds are to be transferred and then physical possession of the land is to be obtained. Land transfer effected means the physical transfer of land to MCA. This is a challenging task. This indicator will help in tracking the progress of this critical activity.
Level: Process indicator.
Classification: Cumulative.
Disaggregation: Based on project package and type of land, such as private/ government/ agriculture/ forest and based on income groups, poverty level.

Data Required: Total number of parcels of land to be acquired and number of parcels for which physical possession has been obtained.
Data Source: ESMS Consultant/Manager, monthly progress reports and MCA package manager
Data Quality: Dependable.
Baseline and Target: Baseline = 0, Target = to be determined after identification of land owner (B)
Interim Target:

Year 1:	80% of B	Year 2:	100% of B	Year 3:	100% of B	Year 4:	100% of B	Year 5:	100% of B

Reporting Frequency: Monthly.

[A-3.1] Number of Land Transfers Effected (for a package)

This indicator is same as [A-3], but will be measured for specific project package by the MCA package manager.

[P-7] Transmission Lines Upgraded or Built For all packages

Unit: Kilometers.
Definition: The sum of linear kilometers of new, reconstructed, rehabilitated, or upgraded (by higher capacity of conductor/tower) transmission lines that have been energized, tested and commissioned with MCC support.
Guidance: Electrical lines of 66 kV or above shall be classified as transmission lines. Transmission consists of all lines connecting the generation packages to transmission substations.
Level: Output indicator.
Classification: Cumulative.
Disaggregation: Based on packages.
Data Required: Length of the transmission line constructed.
Data Source: The required data will be gathered from the package contractor responsible for the construction of the transmission line and monthly progress report.
Data Quality: Reliable.
Baseline and Target: Baseline = 0, Target = 642 km (A).
Interim Target:

Year 1:	5% of A	Year 2:	20% of A	Year 3:	50% of A	Year 4:	80% of A	Year 5:	100% of A

Reporting Frequency: Monthly.

[P-7.1] Transmission Lines Upgraded or Built (For a package)

This indicator is same as [P-7], but will be measured for specific project package.

[P-7.2] Number of Tower Foundations Constructed (For a package)

Unit: Number.
Definition: The number of foundations constructed for transmission towers.
Guidance: The tower foundation is a critical item both for technical and land acquisition purposes. Once the tower foundation is successfully built, the chances of any land or right of way issue arising are unlikely to occur. The data will be for the number of foundations constructed divided by the total number of foundations to be constructed.

Level: Process Indicator.
Classification: Cumulative.
Disaggregation: None
Data Required: Number of foundations constructed for transmission towers.
Data Source: The required data will be gathered from the package contractor responsible for the construction of the transmission line foundation and by package inspections. The data can also be gathered from monthly progress report.
Data Quality: Dependable.
Baseline and Target: **Baseline** = 0**, Target =** 1860 (A)
Interim Target:

Year 1:	10% of A	Year 2:	50% of A	Year 3:	81% of A	Year 4:	95% of A	Year 5:	100% of A

Reporting Frequency: Monthly.

[P-7.3] Number of Towers Constructed

Unit: Number.
Definition: The number of transmission towers constructed.
Guidance: The tower construction is a critical item in the construction of the transmission line. Typically, tower construction means 60 to 70% completion of the transmission line work. Once the tower is successfully erected, the chances of any land or right of way issue arising are unlikely to occur while the conductor is being strung. Number of towers constructed will be the number of foundations constructed divided by the total number of foundations to be constructed.
Level: Process Indicator.
Classification: Cumulative.
Disaggregation: Based on packages.
Data Required: Number of foundations constructed for transmission towers.
Data Source: The required data will be gathered from the package contractor responsible for the construction of the transmission line foundation and by site inspection.
Data Quality: Dependable.
Baseline and Target: Baseline = 0, Target = 1860 (A).
Interim Target:

Year 1:	8% of A	Year 2:	40% of A	Year 3:	75% of A	Year 4:	85% of A	Year 5:	100% of A

Reporting Frequency: Monthly.

[P-8] Transmission Throughput Capacity Added

Unit: Megawatts.
Definition: The increase in throughput capacity, measured in megawatts, added by new, reconstructed, rehabilitated, or upgraded transmission lines that have been energized, tested and commissioned with MCC support.
Guidance: The target for the indicator should be informed by feasibility and load flow studies of the relevant MCC investment in the transmission network, and should reflect the increase in capacity of the network to transmit electricity between key transmission and distribution nodes. At minimum, the indicator should be reported as an overall change in network throughput capacity. However, as feasible and appropriate, the value of the indicator should be disaggregated by voltage level. Values reported across separate investments in higher-

capacity lines at different parts of the network are not additive with each other, so reporting on the indicator cannot be easily aggregated across the whole network, although more detailed modeling may allow for this. The value of this indicator should ideally be informed by load flow analysis after the new or upgraded lines have been energized, tested and commissioned. The throughput capacity data will be collected with the help of feasibility and load flow studies done for the transmission system.

Level: Output indicator.

Classification: Level.

Disaggregation: Based on packages.

Data Required: New transformation capacity added.

Data Source: The data can be collected from the package manager based on the transformation capacity of the substation added or upgraded. The substation capacity added into the Nepal grid will only be counted here. It can be later verified by load flow studies.

Data Quality: Reliable.

Baseline and Target: **Baseline** = 0**, Target =** 778 MW (For the year 2023[4])

Interim Target: To be decided by more detailed load flow study.

Reporting Frequency: Quarterly.

[P-9] Transmission Substation Capacity Added

Unit: Megavolt amperes (MVA).

Definition: The total added transmission substation capacity, measured in megavolt amperes that is energized, commissioned and accompanied by a test report and supervising engineer's certification resulting from new construction or refurbishment of existing substations that is due to MCC support.

Guidance: This indicator shall include the total capacity installed at a substation. As this is an output indicator, and not an outcome indicator, it will not take into account mitigating circumstances that may lower the capacity available at a substation, such as percentage of use or reserve capacity in substations.

Level: Output indicator.

Classification: Cumulative.

Disaggregation: Based on packages.

Data Required: Total capacity of transformers added and upgraded (after energization).

Data Source: The data can be collected from the package manager or from Grid Operation Department of the NEA.

Data Quality: Reliable

Baseline and Target: Baseline = 0, Target = 3840 MVA (A)

Interim Target:

Year 1: 5% Year 2: 30% Year 3: 45% Year 4: 65% Year 5: 100%

Reporting Frequency: Quarterly.

[P-9.1] Length of Entry Road Constructed

Unit: KM.

Definition: The length of entry road constructed to approach the substation.

[4] Based on PSSE load flow study for the year 2023 for all counterfactual base case and all MCC projects. For further details refer section 3.1.8 of volume 1 report

Guidance: The length of entry road constructed to approach substation including widening of roads is an important activity. The transformer can only be transported to the side when the proper entry road is ready.
Level: Process Indicator.
Classification: Cumulative.
Disaggregation: Based on packages.
Data Required: Length of entry road constructed.
Data Source: The required data will be gathered from the package contractors responsible for the construction of the entry road and by site inspection. It will be the road in meters completed divided by the total road in meters to be constructed.
Data Quality: Dependable.
Baseline and Target: Baseline = 0, Target = 21 KM (to be amended when the detailed design is ready).
Interim Target:
Year 1: 40% Year 2: 90% Year 3: 100% Year 4: 100% Year 5: 100%
Reporting Frequency: Quarterly.

[P-9.2] Transformers Available at Package

Unit: Number.
Definition: Number of transformers at project package.
Guidance: The number of transformers available at the project package that are ready for commissioning.
Level: Process Indicator.
Classification: Cumulative.
Disaggregation: None.
Data Required: Number of transformers at the project package.
Data Source: The required data will be gathered from the MCA package manager.
Data Quality: Reliable
Baseline and Target: Baseline = 0, Target = to be decided later based on delivery schedule of the contractor
Interim Target: to be decided later based on delivery schedule of the contractor.
Reporting Frequency: Quarterly.

[P-9.3] Breakers and Isolators Available at Package

Unit: Number.
Definition: Number of beakers and isolators at the project package.
Guidance: The number of beakers and isolators available at the project package that are ready for commissioning.
Level: Process Indicator.
Classification: Cumulative.
Disaggregation: None.
Data Required: Number of beakers and isolators at the project package.
Data Source: The required data will be gathered from the MCA package manager.
Data Quality: Reliable.
Baseline and Target: Baseline = 0, Target = to be decided later, based on the delivery schedule of the contractor
Interim Target: To be decided later based on delivery schedule of contractor.

Reporting Frequency: Quarterly.

[P-9.4] Switchgear Panels Available at Package

Unit: Number.
Definition: Number of switchgear panels at the project package.
Guidance: The number of switchgear panels available at the project package that are ready for commissioning.
Level: Process Indicator.
Classification: Cumulative.
Disaggregation: None.
Data Required: Number of switchgear panels at the project package.
Data Source: The required data will be gathered from MCA package manager.
Data Quality: Reliable.
Baseline and Target: Baseline = 0, Target = to be decided later, based on the delivery schedule of the contractor
Interim Target: To be decided later, based on the delivery schedule of the contractor
Reporting Frequency: Quarterly.

[A-4] Number of Transmission Substations Upgraded

Unit: Number.
Definition: The number of transmission substations reconstructed, rehabilitated, or upgraded under the project.
Guidance: Transmission substations of 66 kVA or above shall be classified as transmission substations. The number of transmission substations reconstructed, rehabilitated, or upgraded under the project.
Level: Output indicator.
Classification: Cumulative.
Disaggregation: Based on packages.
Data Required: No. of transmission substations reconstructed, rehabilitated or upgraded.
Data Source: Quarterly Progress Report and Inspection Reports
Data Quality: Dependable.
Baseline and Target: Baseline = 0, Target = 6
Interim Target:

Year 1:	0	Year 2:	0	Year 3:	4	Year 4:	5	Year 5:	6

***Reporting Frequency*:** Quarterly.

[A-5] Area of Land Acquired

Unit: Percent.
Definition: The total area acquired for the project in sq. km divided by the total sq. km area of land required for the project.
Guidance: Land acquisition is a critical activity for the project. Therefore, it needs to be monitored both in terms of area and in number of land parcels (Ref. A-3). Sq. km of land for which physical possession has been obtained divided by total sq. km of land to be acquired.
Level: Output indicator.
Classification: Cumulative.
Disaggregation: Based on project package and type of land such as private/government/agriculture/ forest.

Data Required: Total sq. km of land required and sq. km of land acquired.
Data Source: EASMs consultant /manger, monthly progress reports and MCA package manager
Data Quality: Dependable.
Baseline and Target: Baseline = 0, Target = 83.7 Hectare (A)[5].
Interim Target:

Year 1:	40% of A	Year 2:	80% of A	Year 3:	100% of A	Year 4:	100% of A	Year 5:	100% of A

Reporting Frequency: Monthly.

[P-18] Transmission System Technical Losses (%)

Unit: Percentage.
Definition: 1- [Total megawatt hours transmitted out from transmission substations / Total megawatt hours received from generation to transmission substations].
Guidance: Quarterly estimates should be reported if available; however, data on losses are often unavailable due to insufficient monitoring equipment, and estimates are often made based on periodic loss characterizations or load flow studies. Data quality reviews can also serve to improve estimates at the baseline while recommending steps to improve the accuracy of estimates during the compact. In some cases, this indicator may not be appropriate to use if there are separate incorporated entities responsible for operating the transmission network, where the utility company may only be responsible for distribution – especially if the compact is only focusing on one subsector (e.g., distribution).
Level: Outcome indicator.
Classification: Level.
Disaggregation: Based on packages.
Data Required: Total MW hours fed into the grid and total MW hours supplied by the grid.
Data Source: Periodic substation reports and aggregation of the energy input and output from various feeders through SCADA.
Data Quality: Reliable.
Baseline and Target: Baseline = 2.42%[6] (For 2023), Target = 2.13%[7] (For 2023)
Interim Target: To be fixed by detailed load flow study for each year.
Reporting Frequency: Quarterly.

[A-6] Number of Capacity Building Programs

Unit: Number.
Definition: Sum of capacity building programs conducted for stakeholders, staff, vendors, land owners, etc.
Guidance: The training will be conducted by different entities, such as MCA, vendors, consultants etc. for different stakeholders at different locations. Any well announced formal capacity building program will be counted as one training session. The required numbers will

[5] Refer excel sheet – 'Resettlement Cost Estimate' of Volume 3 for details.
[6] Based on PSSE load flow study for the year 2023 for all counterfactual base case. For further details refer section 3.1.8 of volume 1 report. As per annual report of NEA the Transmission losses for the FY 2015-16 is 4.82%.
[7] Based on PSSE load flow study for the year 2023 for all counterfactual base case and all MCC projects. For further details refer section 3.1.8 of volume 1 report.

come from vendors, contractors and training institutes which will be mentioned in periodic report.
Level: Outcome indicator.
Classification: Cumulative.
Disaggregation: Male/female participants and on poverty level.
Data Required: No. of training sessions held.
Data Source: Workshops and training program reports; quarterly progress reports
Data Quality: Reliable.
Baseline and Target: Baseline = 0, Target = to be decided later
Interim Target: To be decided when target is fixed.
Year 1: Year 2: Year 3: Year 4: Year 5:
Reporting Frequency: Quarterly.

[A-7] Capacity utilization Factor of a Transmission Line

Unit: Percentage (%)
Definition: The ratio of peak loading on the transmission line (in Amperes) segment in a quarter and design capacity[8] of the line.
Guidance: This indicator will measure the capacity utilization of the transmission line segment vis-à-vis its design capacity. Normally, the design capacity of the line is much higher than the normal loading to clear the fault currents. Therefore, this indicator should be interpreted considering this fact. The peak loading in the quarter of a line is the highest value of the current flown on that line at any instant of time in the quarter. Obviously, transient loading due to a fault or any other impulse should not be considered for determining the peak value.
Level: Output indicator.
Classification: Level.
Disaggregation: For each transmission line segment.
Data Required: Peak value in a quarter
Data Source: SCADA system installed at the substation to which the line is connected
Data Quality: Reliable.
Baseline and Target: Baseline= 0% Target = 50% (assuming a design safety factor of 2)
Reporting Frequency: Quarterly.

[PC-1] Increase in Energy Consumed per Capita

Unit: kWh/capita
Definition: Increase in number of unit of electricity consumed per capita.
Guidance: This indicator will measure the difference in energy consumed per person. This indicator will indicate the improvement in livelihood of the country. The Increase in energy consumed will be calculated by identifying the difference in energy consumption in the measurement year and base year. To calculate the energy consumed per capita this difference will be divided by population.
Level: Outcome indicator.
Classification: Cumulative.
Disaggregation: Based on packages.
Data Required: Per capita energy consumed at base year; per capita energy consumed in the measuring year; population of country.

[8] The design capacity of the transmission lines, in Amperes, are: 4558 (NR1, T8 and XB1) / 914 (T2') / 747 (T3)/ 870 (NR3) /962 (NR4). The name of the line segments has been mentioned in brackets.

Data Source: NEA report.
Data Quality: Dependable.
Baseline and Target: **Base Line=** 133 kWh (2015)[9]
***Target* =** to be decided based on the master plan of transmission and distribution system.
Interim Target: to be decided based on the master plan of transmission and distribution system
Reporting Frequency: Yearly.

[PC-2] Alleviation of Electricity Shortage (Load Shedding)

Unit: GWh
Definition: The deliberate shutdown of electric feeders, generally to prevent the failure of the entire power system when power supply is lower than demand at transmission level.
Guidance: This indicator can be calculated by identifying the change in load shedding period in the measuring year and base year.
Level: Outcome indicator.
Classification: Cumulative.
Disaggregation: Based on packages.
Data Required: Duration of load shedding in base year; Duration of load shedding in the year of measurement.
Data Source: SCADA and NEA Reports.
Data Quality: Dependable.
Baseline and Target: Baseline = 3925 GWh (For 2023)[10], Target = 1562 GWh (For 2023)[11]
Interim Target: to be decided based on the master plan of transmission and distribution system.
Reporting Frequency: Yearly.

[PC-3] Change in System Average Interruption Duration Index (SAIDI)

Unit: Hours.
Definition: SAIDI is the average outage duration for each customer served and is commonly used as a reliability indicator. (For transmission)
Guidance: SAIDI can be calculated by dividing duration of interruption in minutes by number of customers.
Level: Outcome indicator.
Classification: Cumulative.
Disaggregation: Based on packages.
Data Required: Duration of interruption in minutes; number of customers.
Data Source: In the SCADA system, data will be based on the feeders energized or de-energized leaving the cases of scheduled maintenance.
Data Quality: Reliable.

[9] http://mof.gov.np/ieccd/pdf/Energy_NPPR_2015.pdf

[10] Based on PSSE load flow study for the year 2023 for all counterfactual base case. For further details refer section 3.1.8 of volume 1 report.
[11] Based on PSSE load flow study for the year 2023 for all counterfactual base case and all MCC projects. For further details refer section 3.1.8 of volume 1 report.

Baseline and Target: **Baseline** = 251.81 Hours[12],
Target: to be decided based on the master plan of transmission and distribution system.
Interim Target: To be decided based on the master plan of transmission and distribution system.
Reporting Frequency: Quarterly.

[PC-4] Change in System Average Interruption Frequency Index (SAIFI)

Unit: Numbers.
Definition: SAIFI measures the average number of interruptions experienced by each customer. All planned and unplanned interruptions are used in calculating the index. (For transmission)
Guidance: SAIFI can be calculated by dividing number of interruptions during one year by number of customers.
Level: Outcome indicator.
Classification: Cumulative.
Disaggregation: None.
Data Required: Number of interruptions during one year; number of customers.
Data Source: In the SCADA System, data will be based on the feeders energized or de-energized leaving the cases of scheduled maintenance.
Data Quality: Reliable.
Baseline: *235*[11]
Target: To be decided based on the master plan of transmission and distribution system.
Interim Target: To be decided based on the master plan of transmission and distribution system.
Reporting Frequency: Quarterly.

[PC-5] Percent Households Electrified

Unit: Percentage.
Definition: The process by which access to electricity is provided to households or villages located in the isolated or remote areas of a country.
Guidance: The ratio of number of households electrified with total number of houses.
Level: Outcome indicator.
Classification: Cumulative.
Disaggregation: Urban/rural, poverty level.
Data Required: Total number of households; number of households electrified.
Data Source: Central Bureau of Statistics, Nepal; third party surveys.
Data Quality: Dependable.
Baseline and Target: Base line= 67% (2011)[13]
Target = To be decided based on the master plan of transmission and distribution system.
Interim Target: To be decided based on the master plan of transmission and distribution system.
Reporting Frequency: Yearly.

[12] On the basis of NEA's monthly outage report for the period for June 2015 to May 2016. It includes interruption of any transmission line or its feeders due to any reason including interruptions due to planned shutdown, operation or maintenance, etc.
[13] http://conference.ioe.edu.np/ioegc2014/papers/IOE-CONF-2014-34.pdf

[PC-6] Increase in power flow (import and export) from neighboring countries

Unit: GWh.

Definition: Sale and purchase of electric power between two countries on the basis of demand and supply.

Guidance: There will be sale and purchase of electricity between two countries through the power transmission network as per the demand and supply requirements in the countries. The import and export of the electricity can be measured through net meters.

Level: Outcome indicator.

Classification: Cumulative.

Disaggregation: Import/export.

Data Required: Cross-border trade of electricity.

Data Source: In the SCADA system, data will be based on the power flow through cross border feeders.

Data Quality: Reliable.

Baseline and Target: Baseline= 6,000, Target = 14,200 in 2023.[14]

Interim Target: To be determined by more detailed load flow studies for each year.

Reporting Frequency: Yearly.

[14] Load flow study for 2023 scenario with base case and all MCC projects. For more details refer "Power System Assessment" section of the Task 1 report.

4. Data Collection

4.1 Data Flow

The data required for the measurement of performance indicators have been specified in Section 3. However, to develop an IT-enabled automatic M&E framework, it is important to define from where data will originate, who will collect it, and how the data will flow into an MIS software tool. Table 6 specifies origination points, travel paths, and final destinations for the data required for the recommended 33 performance indicators.

Table 6. Flow of Data for the Measurement of Performance Indicators

Indicator	Data Flow		Description/ Use Cases
	Origination	Via/final destination	
P-1	MCA System	Central Database	It is assumed that the MCA will set-up an in-house system as part of their office establishment. The contracts and payment will be administered and managed through this system. The data will flow from this system to web-based project management software as per the system logics (it can be instantaneous/daily).
P-1.1	MCA System	Central Database	
P-2	MCA System	Central Database	
P-2.1	MCA System	Central Database	
P-3	MCA Technical Consultants	Central Database	
P-4	MCA Technical Consultants	Central Database	
P-5	Site Contractor	MCA Package Manager to Central Database	The MCA Package Manager will collect information from all contractors about the workers employed (only direct employees) on the project.
P-7	Site Contractor	MCA Package Manager to Central Database	The MCA Package Manager will collect information from the site contractor and verify through visual inspection the authenticity of the data provided by the site contractor.
P-7.1	Site Contractor	MCA Package Manager to Central Database	
P-7.2	Site Contractor	MCA Package Manager to Central Database	
P-7.3	Site Contractor	MCA Package Manager to Central Database	
P-8	Site Contractor	MCA Package Manager to Central Database	The MCA Package Manager will collect data from the substation commissioning results.
P-9	Site Contractor	MCA Package Manager to Central Database	
P-9.1	Site Contractor	Central Database	The MCA Package Manager will collect information from the site contractor and verify it through visual inspection the authenticity of the data provided by the site contractor.

Table 6. Flow of Data for the Measurement of Performance Indicators

Indicator	Data Flow		Description/ Use Cases
	Origination	Via/final destination	
P-9.2	MCA package Manager	Central Database	The MCA Package Manager will feed the information based on visual confirmation.
P-9.3	MCA package Manager	Central Database	
P-9.4	MCA package Manager	Central Database	
P-18	SCADA	Central Database	The information will be directly fed from the SCADA to the Central Database. The information will flow as per the SCADA logic (it can be instantaneous/daily).
A-1	Site Contractors	MCA Technical Consultants - MCA System - Central Database	The contractors will follow the ESMS and technical consultants/ Project Management Consultant (PMC) will monitor its adherence.
A-2 & A-2.1	MCA Technical Consultants/ PMC MCA Package Manager	MCA System - Central Database Central Database	The public grievances received at the MCA level will be entered into the MCA system by the MCA/technical consultants/ PMC The public grievances received at the site office will be entered by the MCA package manager manually into a web-based tool.
A-3	MCA Package Manager	PMC - MCA system- Central Database	The MCA Package Manager will collect information on the number of land acquisitions for the project and will provide this information to MCA. The PMC will enter the information in the MCA system.
A-3.1	MCA Package Manager	PMC - MCA system- Central Database	
A-4	MCA Package Manager	PMC - MCA system- Central Database	The MCA Package Manager will collect information on the number of substations upgraded for the project and will provide this information to MCA. The PMC will enter the information in the MCA system.
A-5	MCA Package Manager	PMC - MCA system- Central Database	The MCA Package Manager will collect information on land acquisitions for the project and will provide this information to MCA. The PMC will enter the information in the MCA system.
A-6	MCA System	Central Database	It is assumed that the details of all the training programs from, their conceptualization to their completion, will be captured in the MCA system.
A-7	SCADA	Central Database	The design value has been provided in the Footnote #8 on Page 23 (Section 3). The quarterly peak value can be obtained from the quarterly reports generate through the SCADA of the substation to which the line is connected.
PC-1	SCADA	Central Database	It is assumed SCADA at load dispatch center will get connected to all transmission sub stations.
PC-2	SCADA	Central Database	

Table 6. Flow of Data for the Measurement of Performance Indicators

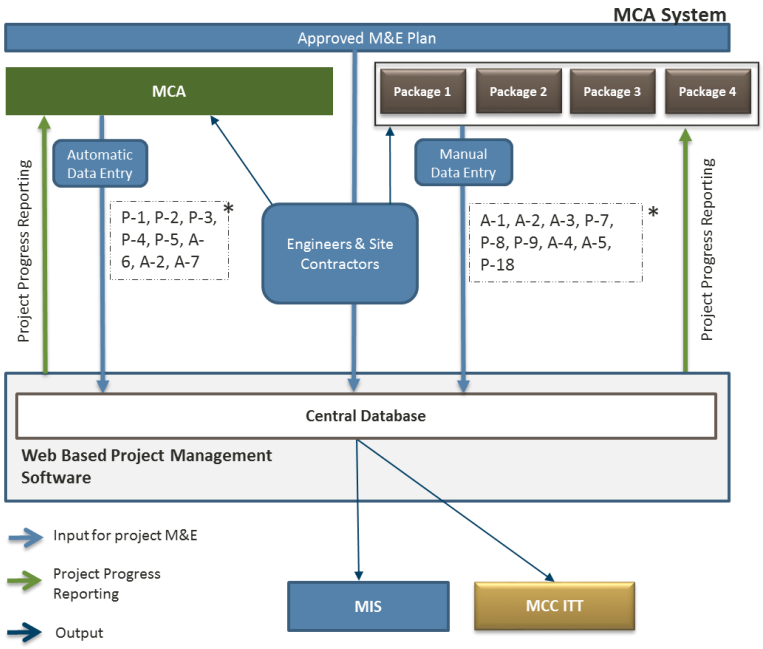
Indicator	Data Flow		Description/ Use Cases
	Origination	Via/final destination	
PC-3	SCADA	Central Database	
PC-4	SCADA	Central Database	
PC-5	Survey	Central Database	
PC-6	SCADA	Central Database	

4.2 Data Collection

Our high-level approach for the collection of data for each of the recommended performance indicators can be divided in two parts:

- During compact
- Post compact.

During Compact: We have tried to capture the maximum amount of data that can be obtained without relying on human interface (data that can be collected automatically). However, some of the data, such as number of towers erected, transmission line completed, etc. cannot be system fed. For such data, a web-based system/window will be provided to MCA package managers. This window will be part of central MIS system. The data will be processed using project management software and will generate reports as specified in the M&E plan from central MIS system. The architecture of data collection during compact period is provided in Figure 2.



*: Please refer to Table 6 for further elaboration

Figure 2. Data Collection Architecture during Compact Period.

Post Compact

After the completion of the compact, the transmission system will be handed over, either to NEA or to the new transmission entity, which will be responsible for measuring these performance indicators and reporting to MCC. We have recommended six indicators (From PC-1 to PC-6) for post compact monitoring. PC-1 and PC-2 are calculated by all utilities and NEA is no exception. PC-1 is determined on annual basis and published in the annual report of NEA. PC-2 is monitored by utility on daily basis due to several reasons and report is generated by Load Dispatch Centre every day in the morning for previous 24 hours. For the MCC purpose it may not be relevant as daily report reflects more operational issues. From MCC perspective it is important to look at it on annual basis what was the total number of megawatt-hours of load shedding in the previous year and how has it changed on an annual basis. Similar is the situation with PC-3, PC-4 and PC-6. It will be possible to generate reports for PC-2 to PC-4 and for PC-6 at any point of time from new SCADA KfW[15] is installing at NEA's load dispatch center (LDC). However to have a meaningful assessment of impact and improvement one year period is reasonable. PC-5 will be captured (data collected from field units) and published by NEA.
Generally, these indicators will merge with the MIS of the transmission company. The MIS system of the NEA is described in detail in Section 2.1.

As part of our substation design, we have provided meters and remote telemetry units (RTUs) at appropriate locations to capture the data required for measuring the performance indicators P-18, PC-3, PC-4 and PC-6. The data from the substation will be transmitted to the SCADA[16] with the help of the RTU and normal communication links between substations and SCADA. The reports on these indicators will be generated either at the SCADA level or data will flow from the SCADA to the transmission company's MIS for the generation of the reports. The latest SCADAs have provisions for formatting reports as per the requirements specified. A high-level graphic representation of this is provided in Figure 3. The substation layout/design provided in the Task 1 (Volume 1) report covers placement and interconnection of meters and RTUs.

Thus, in terms of resources there is no specific requirement for the suggested post compact indicators as they will be monitored by NEA (or the transmission company) even without the Compact. Since these indicators will be measured through on line systems (SCADA) and data stored in software, there is hardly any scope for improvement of the quality of the data. The improvement is required in terms utilizing the features of SCADA for generation of reports. This depends upon several factors such as, LDC staff willingness, MIS demand of the top management and their push for system generated reports. As far as LDC staff is considered KfW has made sufficient provisions for capacity building of the NEA staff.

[15] Although such report generation is standard feature of modern SCADA system but in this case we have confirmed with KfW also.
[16] The SCADA mentioned in this document refers to the SCADA of Load Dispatch Center.

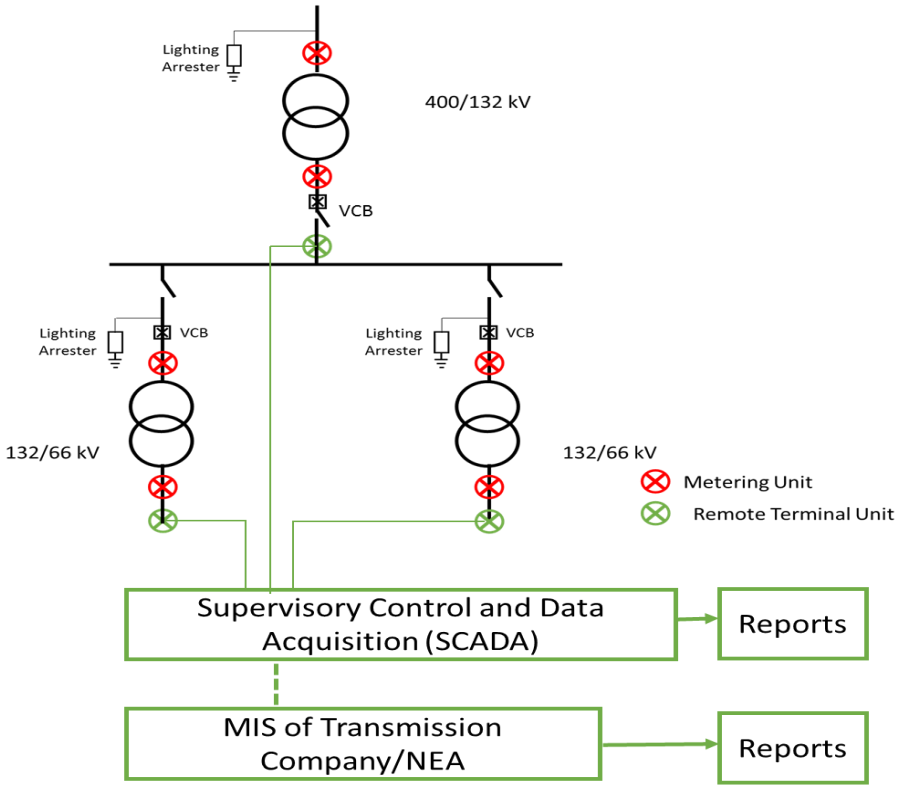


Figure 3. Approach to Measure Post-Compact Indicators

5. Measurement and Reporting

5.1 Measurement

The data for all the 33 PIs will come either from site, MCA system, SCADA, or surveys. This section describes how this data will be used to determine/calculate the PIs. Figure 4 provides a graphic representation of the measurement approach of PIs.

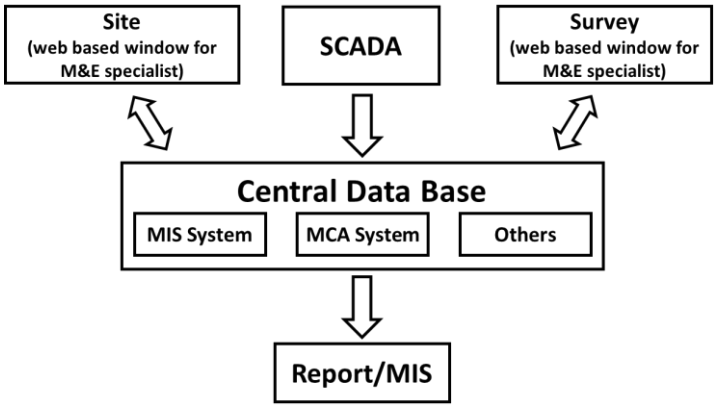


Figure 4. Measurement of PIs

Data from the Site: The data for performance indicators P-5, A-1, A-2, A-2.1, A-3, A-3.1, P-7.2, P-7.3, P-9.1, P-9.2, P-9.3 and P-9.4 will come from the site. These data will be entered manually by the MCA Package Manager in a web-based window that will be connected to the central database of the MCA. This web-based system can be accessed through the internet with the help of an internet browser. The MCA Package Manager needs to access the webpage on his laptop/desktop and log in with his user identity and password. The MIS software installed in the central database will retrieve these data and determine/calculate appropriate PIs.

Data from the MCA System: Data for the performance indicators P-1, P-1.1, P-2, P-2.1, P-3, and P-4 will be come from the MCA system. The central database is common for all data. Thus, no flow will take place and these PIs will be determined/calculated as per the logics defined in MIS software.

Data from SCADA: The data for performance indicators A-7, P-18, PC-1, PC-2, PC-3, PC-4, PC-5 and PC-6 will come from SCADA. This data will enter automatically into the MIS system, which will be connected to MCA's central database. The related report will be generated based on the indicators/parameters.

Data from Survey: To monitor the post-compact indicator PC-5, there will be a need to conduct a survey. The data from this survey will be entered by the M&E Specialist at MCA with the help of a web-based window that will be connected to the central database. This web-based system can be accessed through the internet with the help of an internet browser. The M&E Specialist needs to access the webpage on his laptop/desktop and login with his user identity and password. The MIS software installed in the central database will retrieve these data and will determine/calculate PC-5.

5.2 Reporting

For each of the PIs, we have suggested a frequency of measurement: monthly, quarterly, biannually, and annually. At this stage, we propose to generate only monthly, quarterly, biannual and annual reports. The PIs to be reported in each of these reports are identified in Table 7. However, the MIS software is flexible enough to customize any report as per requirements. The requirements of new types of reports are to be placed with the M&E Specialist. The M&E Specialist will be provided training to customize the report.

Table 7. Report Generated through Performance Indicators

No.	Performance Indicator
Monthly Report	
P-1	Value of signed infrastructure feasibility and design contracts (for compact)
P-1.1	Value of signed infrastructure feasibility and design contracts (for project package)
P-2	Present disbursement of power infrastructure feasibility and design contracts (for compact)
P-2.1	Present disbursement of power infrastructure feasibility and design contracts (for project package)
A-1	Percent completion of Environmental and Social Management Systems
A-2	Number of environmental or social problems associated with the project reported and not yet resolved (for compact)
A.2.1	Number of environmental or social problems associated with the project reported and not yet resolved (specific project package)
A-3	Number of land transfers effected (for compact)
A-3.1	Number of land transfers effected (for project package)
P-7	Transmission line upgraded or built (for compact)
P-7.1	Transmission line upgraded or built (for project package)
P-7.2	Number of tower foundations constructed
P-7.3	Number of towers constructed
A-5	Area of land acquired
Quarterly Report	
P-3	Value of signed power infrastructure construction contracts
P-4	Present disbursement of power infrastructure construction contracts
P-5	Temporary employment generated by power infrastructure construction
P-8	Transmission throughput capacity added
P-9	Transmission substation capacity added
P-9.1	Length of entry road constructed
P-9.2	Transformers available at site
P-9.3	Breakers and isolators available at site
P-9.4	Switchgear panels available at site
A-4	No. of transmission substations upgraded
A-6	Number of capacity building programs
A-7	Capacity Utilization Factor of a Transmission Line
PC-3	Change in System Average Interruption Duration Index (SAIDI)
PC-4	Change in System Average Interruption Frequency Index (SAIFI)

Table 7. Report Generated through Performance Indicators

No.	Performance Indicator
P-18	Transmission system technical losses (%)
Yearly	
PC-1	Increase in Energy Consumed per Unit of Capita
PC-2	Alleviation of Electricity Shortage (load shedding)
PC-5	Percent Households Electrified
PC-6	Increase in power flow (import and export) from neighboring countries.

6. Resource Requirements

To effectively practice monitoring and evaluation, resources will be needed. The resource requirement for monitoring and evaluation can be segregated in three broad parts:

1. Manpower
2. Infrastructure
3. Capacity Building.

Manpower: We recommend **a** team of two full-time persons who will manage the monitoring and evaluation activities during the entire compact period. They can be recruited in first quarter in which the compact comes into force.

M&E Specialist: We propose a full-time Monitoring and Evaluation Specialist at the MCA level who will manage all M&E activities and will be responsible for detailed design, implementation, coordination with SCADA and operation of the MIS system.

M&E Support: To assist the M&E Specialist with such work as the installation, availability and operation of a web-based window on the laptop/desk top of the Package Managers. He/she will follow day-to-day operational guidance to enter data as per requirements and in a timely fashion. This individual will report directly report to the M&E Specialist. The engagement cost of these two resources is estimated in the Table 8.

LOE Calculation:

Total man day input in one month – 26 days (considering one day off in a week)
Total man day input in one year – 312 days (26 days*12 months)
Total vacations and holidays in one year – 45 days
Effective man day input in one year – 267 days (312 days – 45 days)
Effective man day input in five years – 1335 days (267 days * 5 years)

Number of Trips:

Quarter 2 (Year 1) –

M&E Specialist – 8 trips (two trips per package)
Assistant M&E Specialist – 12 trips (one trips per package per month)
Total – 20 trips

Quarter 3 (year 1) –

M&E Specialist – 04 trips
Assistant M&E Specialist – 08trips
Total – 12 trips

Rest of the Compact Period

M&E Specialist – 09 trips (one trip per six month)
Assistant M&E Specialist – 18 trips (one trip per quarter)
Total – 27 trips

M&E Infrastructure: To monitor the performance indicators, infrastructure will be a critical component. We propose MIS software that can be developed by any software developers. However, in order to keep costs low, we suggest using "gold class" subcontractors of big IT firms such as IBM. They will develop software for the PIs, data flow and measurement architecture specified in the sections above. This software will be installed in a central database and can be accessed through a web-based window by MCA Package Managers. The central database will be connected with SCADA for the flow of required data. The connectivity of SCADA with the central database will be in the scope of the MIS software development. Here, we have assumed all MCA staff and Package Manager will be provided with laptop/desk top and internet facility. The cost of this infrastructure is estimated in Table 8.

Capacity Building: To familiarize the monitoring and evaluation staff, there will be a need for a capacity building program so that the manpower involved in project execution can effectively support the M&E activity and can make the best use of it for project progress. We propose to provide detailed MIS software and operational training to the M&E Specialist and M&E Support. This training will include changes in PIs and customization of reports and their frequency. One round of on-site operational training will be provided by the MIS software developer. Subsequently, it will be provided by the M&E Specialist and his support staff as and when needed.

Miscellaneous Activities: We propose that 10% of the estimated budget be dedicated as additional funds for miscellaneous activities.

The estimated cost of the Monitoring and Evaluation Components is shown in Table 8.

Table 8. M&E Budget

Sl. No.	Name of the Component	No of Units	Unit Cost (USD)	Total Cost (USD)
Manpower				
1	M&E Specialist	1335	320 USD/day	337,920
2	M&E Support	1335	200 USD/day	267,000
3	Travel Cost	59	200 USD/trip	11,800
Infrastructure				
4	MIS Software Development	1	25,000	25,000
7	O&M Annual charge	4	1,250	5,000
Capacity Building				
9	Capacity Building	Lump sum	5,000	5,000
			Estimated Cost	**651,720**
10	Miscellaneous	5%	-	32,586
			M&E Cost	**684,306**

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