Best Practices in Planning of New Transmission Systems

"Building a Reliable, Resilient and Future-Ready Grid"

Presented by

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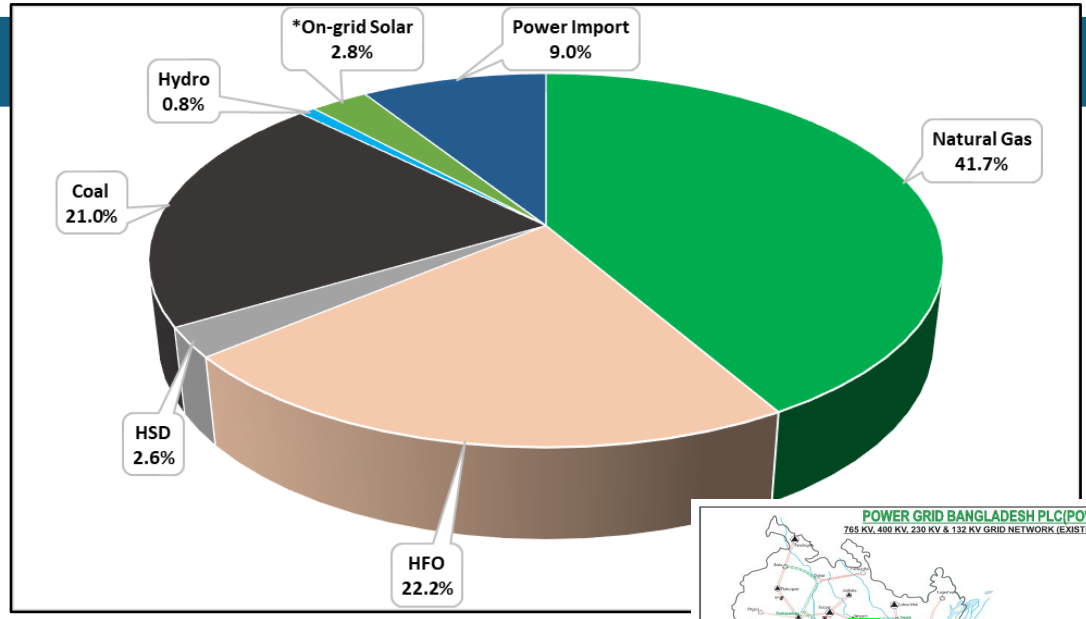
1.0 Bangladesh Power System Overview

1.1 Generation Capacity



❑ Total installed capacity exceeds 28 GW.

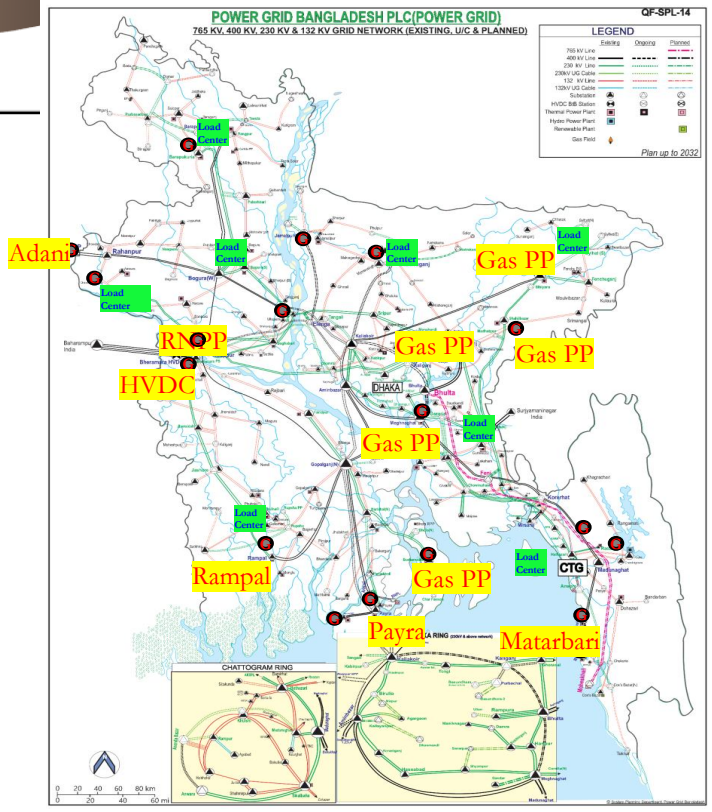
❖Major fuel mix:

- Natural Gas (41.7%)
- Furnace Oil and Diesel (24.8%)
- Coal (21.0%)
- Imported Power (9.0%)

❑ Increasing dependency on imported fuel.

❑ Large baseload generation projects include:

- Payra Thermal Power Plant (1320 MW)
- Rampal Power Plant (1320 MW)
- Matarbari Power Plant (1200 MW)
- Large Gas based power plants (Unit size: 400- 700 MW)
- Upcoming Nuclear Power Plant (2x1200 MW)



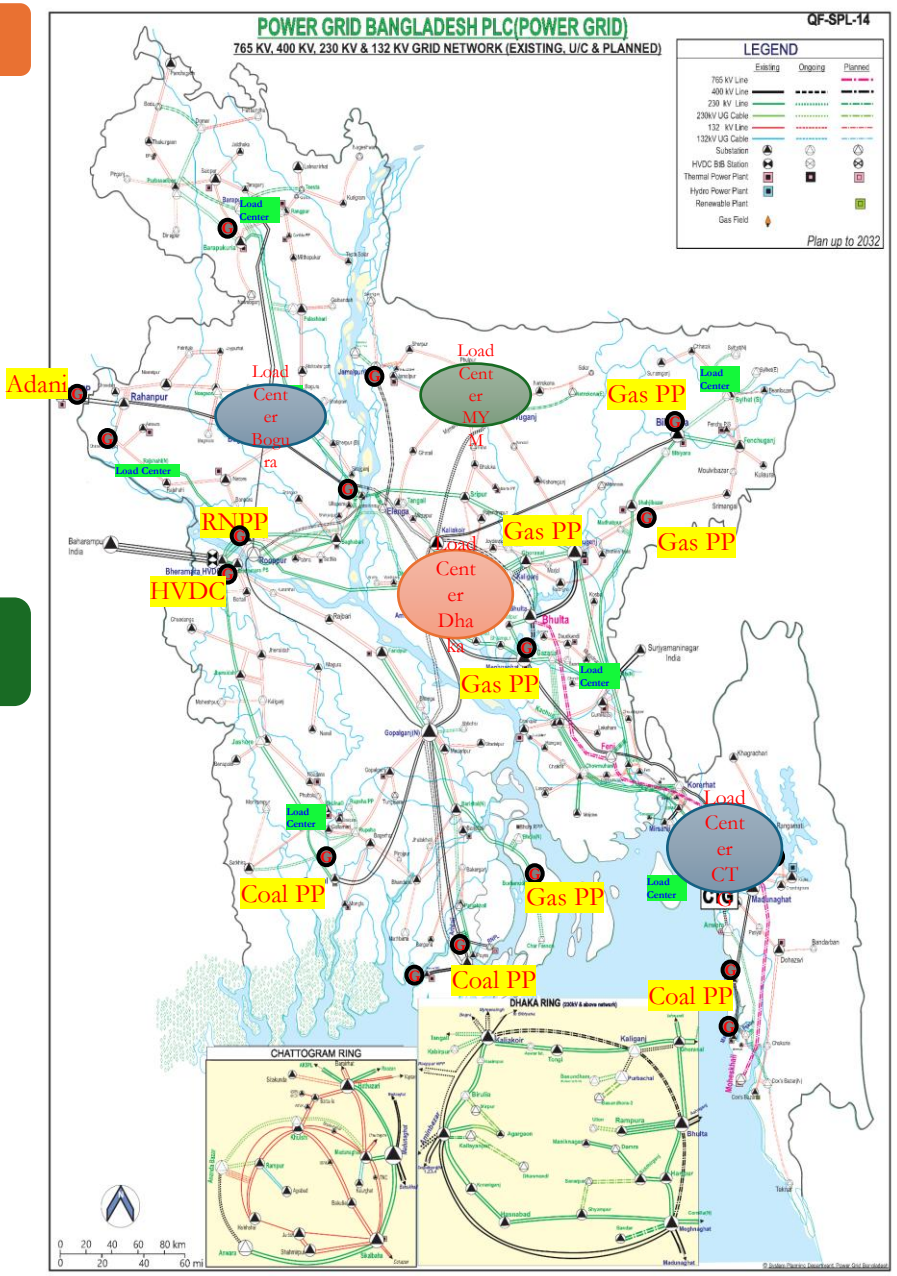
1.0 Bangladesh Power System Overview

1.2 Transmission Network

- Voltage levels: 400 kV, 230 kV, 132 kV
- Existing grid infrastructure includes:
  - National transmission backbone
  - East-West Interconnection
  - Grid substations
- Grid expansion is ongoing to support:
  - Nuclear power evacuation
  - Renewable energy integration

1.3 Load Centers

- Maximum Demand exceed 17 GW
- Major load centers:
  - Dhaka Metropolitan Area, Chattogram
  - Narayanganj ,Gazipur industrial belt
  - Increasing demand from:
    - Industrial sector
    - Economic Zones
    - Urban commercial load



2.0 Key Features of Bangladesh Transmission System

National Grid Structure

- Bangladesh operates a predominantly integrated national grid.
- Eastern and Western zones are interconnected through high-capacity transmission corridors.
- 400 kV network is gradually becoming the primary transmission backbone.

Cross-Border Interconnections

- Existing power import interconnections with India.
- Future prospects:
  - Nepal hydropower import
  - Bhutan hydropower import
  - Expanded regional electricity market

Major Transmission Challenges

- Rapid load growth in urban areas.
- Limited transmission corridor availability.
- Voltage stability concerns.
- Reactive power management challenges.
- High short-circuit level in dense network areas.
- Delays in project implementation.
- Seasonal demand variability.
- Increasing Amount of Renewable Energy in coming days (20% by 2030)

3.0 Power Grid Practices in Transmission Planning

3.1 Transmission Planning Aspects

A. Long-Term Integrated Planning	Prepare rolling master plans with 10–20 year planning horizon.
	Align transmission expansion with national energy policy and economic growth.
	Coordinate planning with generation developers and distribution utilities.
B. Reliability-Based Planning	Ensure N-1 contingency compliance for major transmission corridors.
	Improve system reliability indices.
	Strengthen grid redundancy for critical load centers.
	Reduce forced outages and congestion.
C. High Voltage Network Development	Expand 400 kV transmission network across the country.
	Develop strong transmission backbone for bulk power transfer.
	Reduce dependency on long-distance 132 kV transmission.
	Introduce higher-capacity conductors and advanced tower configurations.

3.1 Transmission Planning Aspects

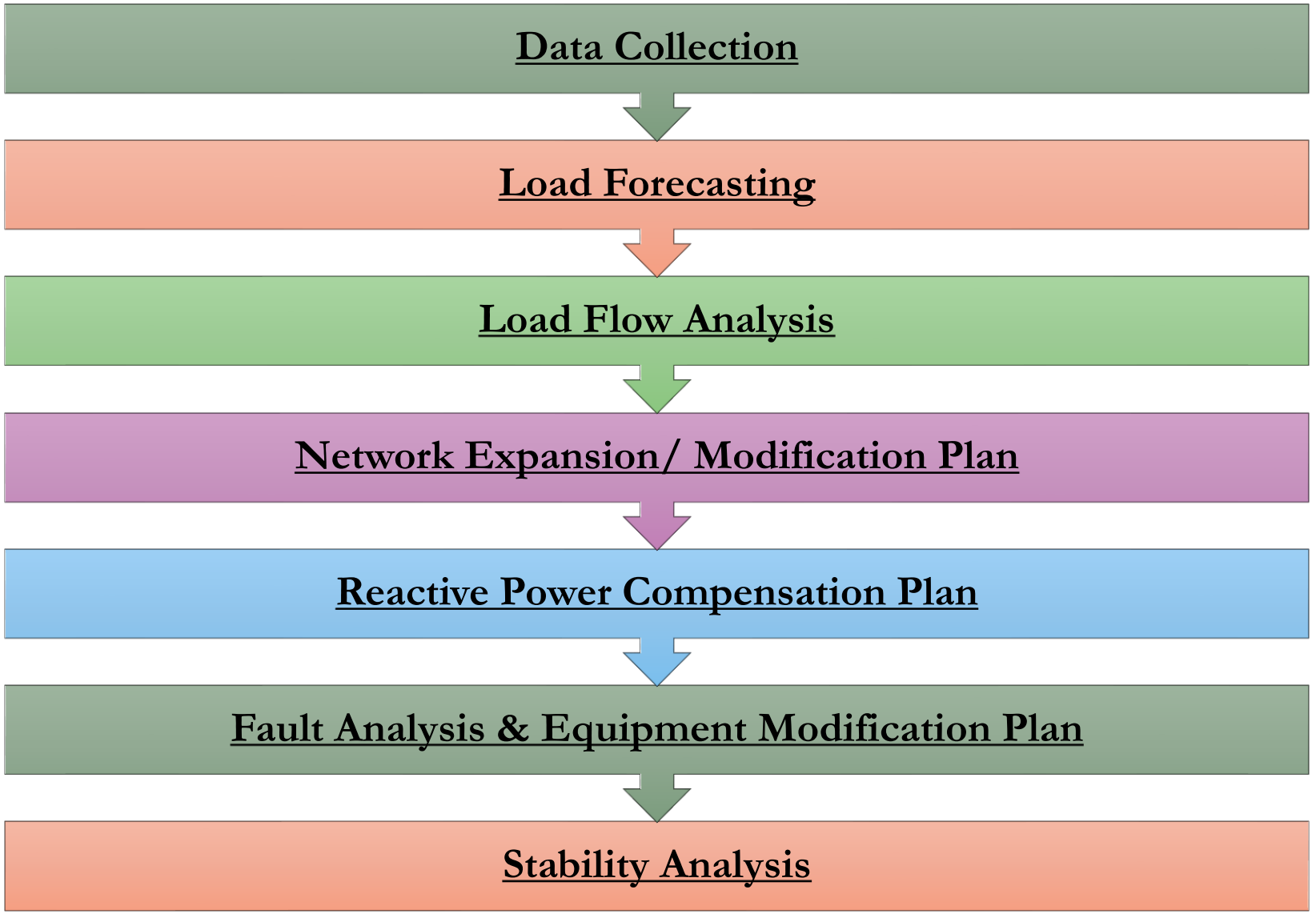
D. Renewable Energy Integration	Enhance grid flexibility for variable renewable energy.
	Incorporate battery energy storage systems (BESS).
	Improve forecasting and dispatch capability.
E. Smart Grid and Digitalization	Implement Wide Area Monitoring System (WAMS).
	Expand SCADA/EMS coverage.
	Utilize PMU-based real-time system monitoring.
F. System Stability Enhancement	Improve voltage stability and transient stability.
	Install reactive power compensation: Reactors, Capacitor bank, SVC, STATCOM
	Enhance frequency response capability.
	Develop robust protection coordination.

3.1 Transmission Planning Aspects

G. Asset Optimization	Maximize utilization of existing transmission assets.
	Apply transmission loss reduction measures.
	Upgrade aging infrastructure.
	Utilize reconductoring where feasible.
H. Climate Resilience and Sustainability	Design climate-resilient transmission infrastructure.
	Address cyclone and flood vulnerability.
	Increase use of environmentally sustainable technologies.
	Consider underground or compact transmission solutions in urban areas.

3.0 Power Grid Practices in Transmission Planning

3.2 Process followed in the transmission planning study



4.2 Process followed in the transmission planning study

A. Data Collection:

Power System Master Plan
Expansion plan of distribution utilities identifying load growth center, substations, reactive power information etc.
Monthly Management Information System (MIS) Report.
Recommendation from system operation (NLDC).
Generation Expansion Plan & Retirement Schedule of Generators (BPDB)

- PSMP 2006: Initial Master plan for the Power Sector
- PSMP 2010 : Long-term planning up to 2030
- PSMP 2016: Vision 2041
- Revisiting PSMP 2016 (2018): Vision 2041
- IEPMP 2023: Integrated with Energy Sector , Up to 2050
- EPSMP 2026: Energy and Power Master Plan, up to 2050 (in process)

B. Load Forecasting:

- Historic Growth Trend
- Load forecasting methods: Delpy Methods & Regression.
- Important considerations: *Per capita consumption growth and electricity intensity in GDP*

C. Load Flow Study:

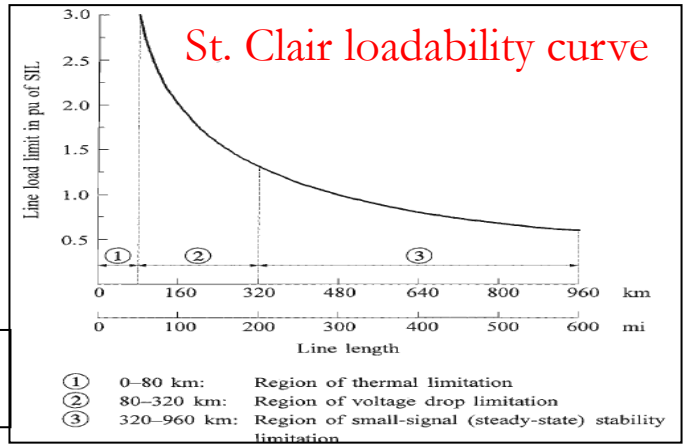
- Load Flow Study Software: PSSE, Power Factory
- Identification of Transmission Systems overloading under different scenario.
- (N-1) contingency analysis.

D. Network Expansion/Modification:

- Basic concept of substation expansion:

Substation	Urban	Rural
400/230 kV	1000-1500 MW	800-1200 MW
230/132kV	500-700 MW	300-500 MW
132/33kV	120-150 MW	60-150 MW (Depending upon 33kV feeders length)

- Basic concept of transmission line expansion:



F. Reactive Power Compensation Plan:

Planning of reactive power compensation requirement is performed considering the following aspects:

- **Location wise generation capacity (MW and MVAR) in the system.**
- **Location wise load requirements (MW and MVAR) in the system.**
- **Allowable voltage limit for 132kV & higher voltage buses. (As per Grid Code)**

G. Fault Current Analysis & Equipment Modification Plan:

- **Software: PSSE, Power Factory (Dig Silent)**
- **Identification of under rated equipment (CB, Isolator)**
- **Phase wise equipment modification plan.**
- **Typical Circuit Breaker Rating: 40kA at 132kV, 50kA at 230kV and 63kA at 400kV**

E. Stability (Voltage) Study:

Electricity Grid Code 2023 Compliance:

The **Transmission System** shall be planned in accordance with the following transmission system planning and security standards.

Voltage limits:	Emergency Condition
Normal Operating Condition ±5% for 400 kV Bus ±6% for 230 kV and 132 kV Bus	±10 % for 400 kV Bus +10/-15% for 230 kV and 132 kV Bus.

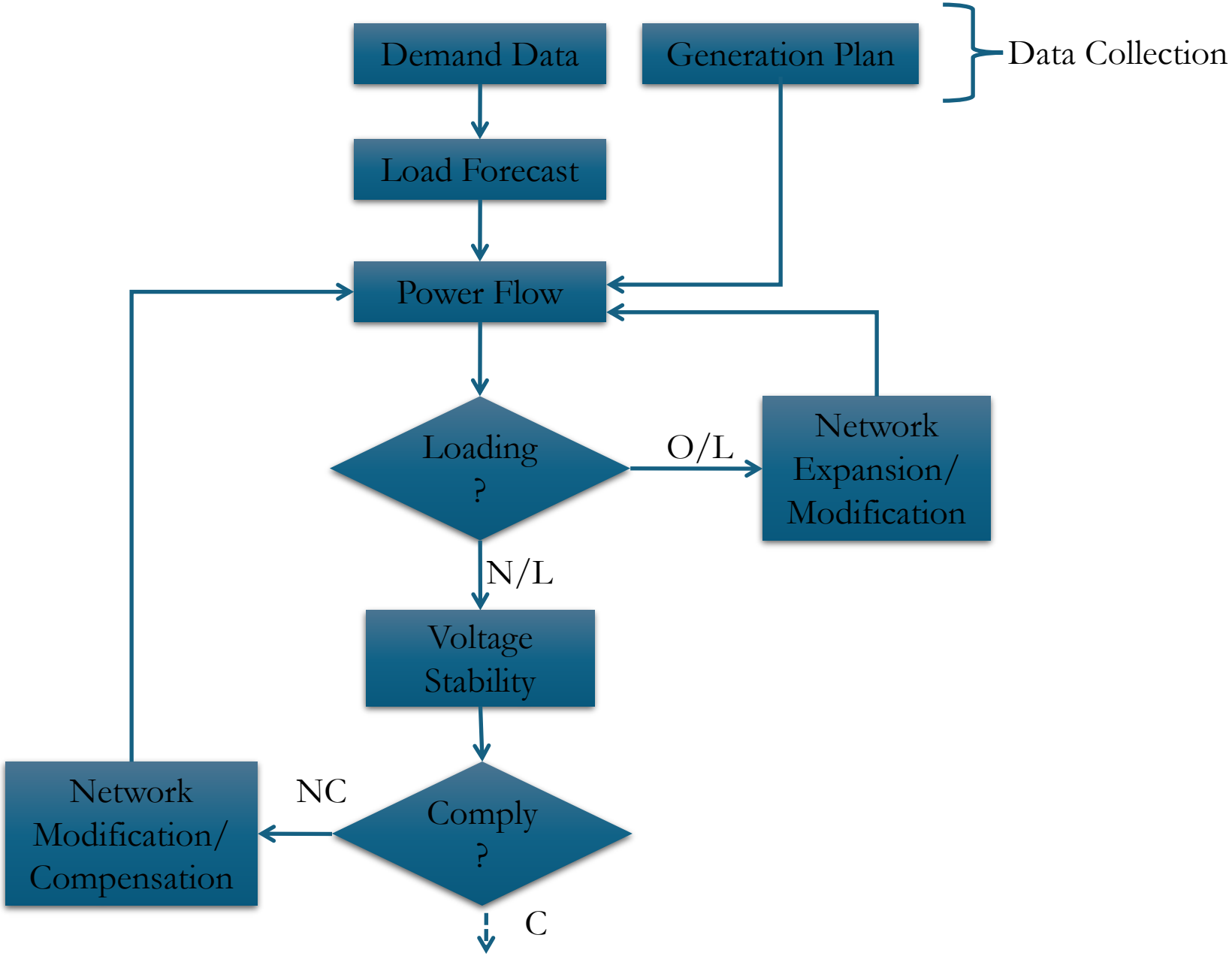
Minimum Contingency Criteria of Transmission Line Outages:

Single contingency (N-1) of a permanent three-phase outage of any one circuit element or transformer.

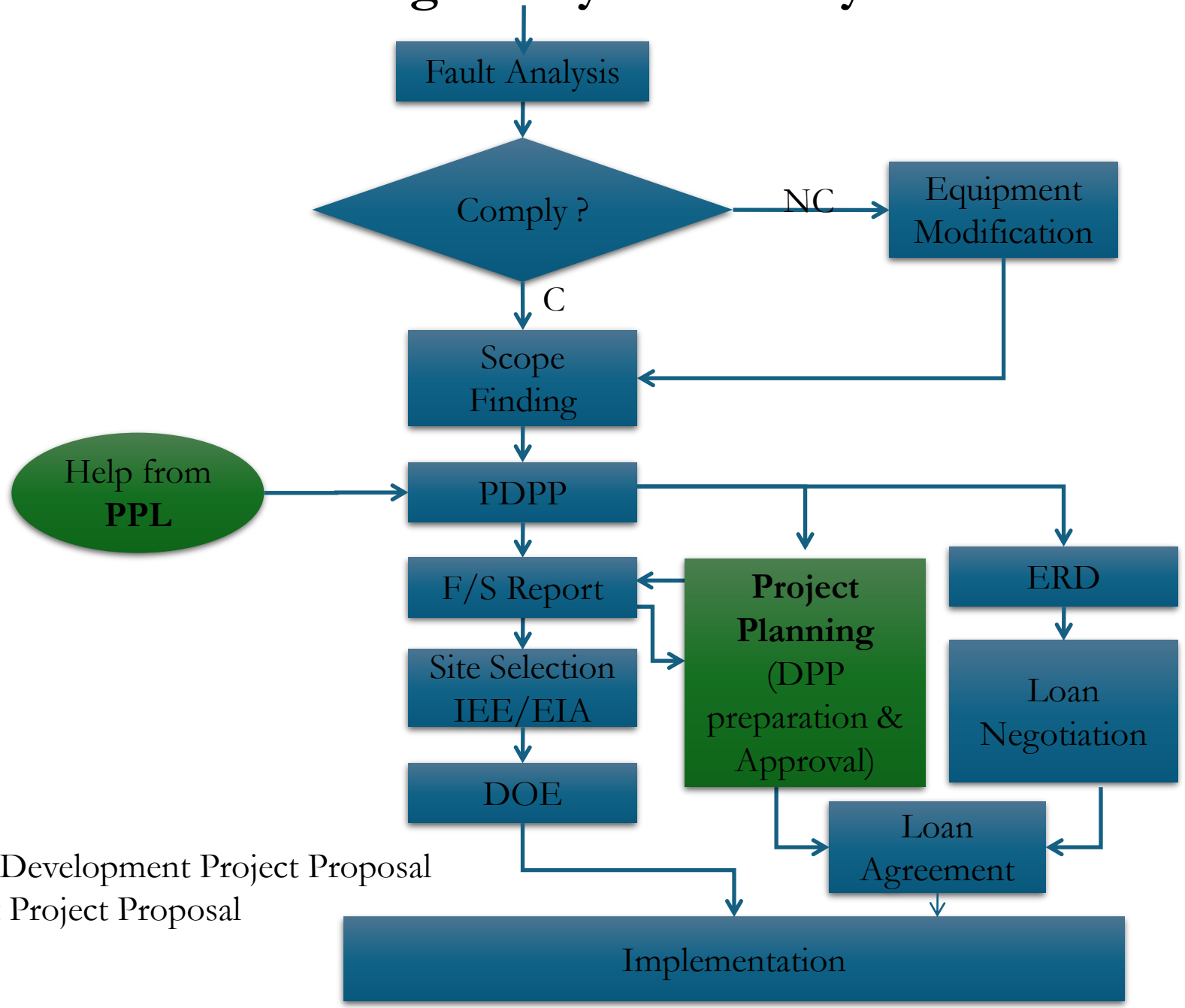
Stability:

Fault clearing time shall be 5 cycles (100 ms). Transiently stable to 3-phase to ground fault with normal clearing.

Flow Diagram of System Study



Flow Diagram System Study



PDPP: Preliminary Development Project Proposal
DPP: Development Project Proposal

4.0 Strategic Transmission Projects in Bangladesh

Rooppur Nuclear Power Evacuation System	Development of 400 kV high-capacity evacuation network.
	Strengthening East-West power transfer capability
East-West Interconnection Enhancement	Expansion of interconnection capacity between eastern and western zones.
	Improvement of system reliability and power transfer capability.
Dhaka Power Supply Strengthening	Urban transmission modernization.
	Reduction of congestion and voltage instability.
Coastal Transmission Development	Transmission infrastructure for southern power hubs including VRE.
	Integration of Payra, Matarbari, and future offshore renewable resources.

5.0 Future Outlook of Bangladesh Power System

Emerging Trends

- Increasing electricity use in transportation and industries.
- Greater renewable energy penetration.
- Expansion of regional power trading.
- Transition toward smart grid operation.
- Increased use of digital technologies and automation.

Planning Priorities

- Reliable and resilient transmission backbone.
- Renewable energy readiness.
- Financially optimized transmission investments.
- Improved operational flexibility.
- Cybersecurity and grid modernization.

Vision for Future Grid

- Strong nationwide 400 kV network.
- Smart and digitally monitored transmission system.
- Sustainable and climate-resilient infrastructure.

Q & A

Thank You