Mumbai–Ahmedabad High-Speed Rail Project (MAHSR)

Overview: Securing Stable Power Supply – Plans & Challenges

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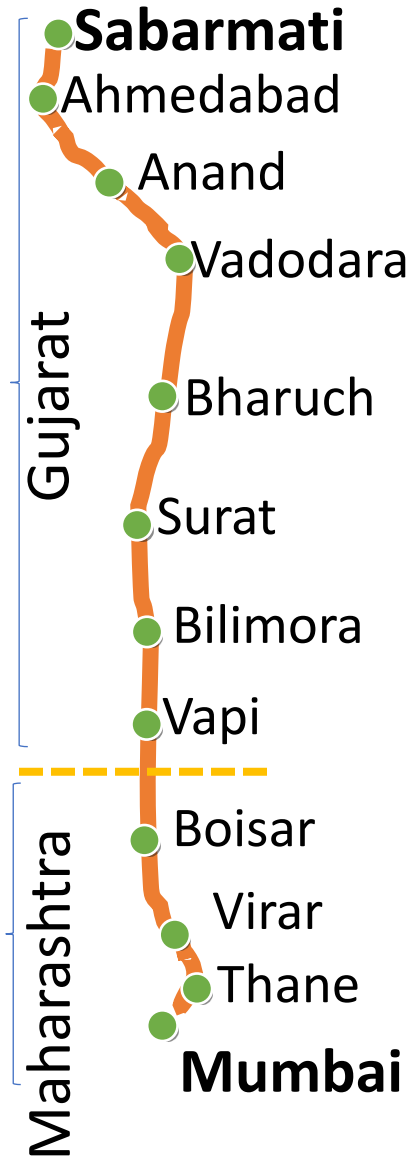
Presentation flow

1. MAHSR Project- *Overview*
2. NHSRCL- *Overview*
3. Power supply Systems *(Traction & Distribution) - Overview*
4. Power supply systems –*Status & Plans*
5. Stable Power supply
6. Power supply system- *Challenges*

MAHSR Project in India- *Overview*

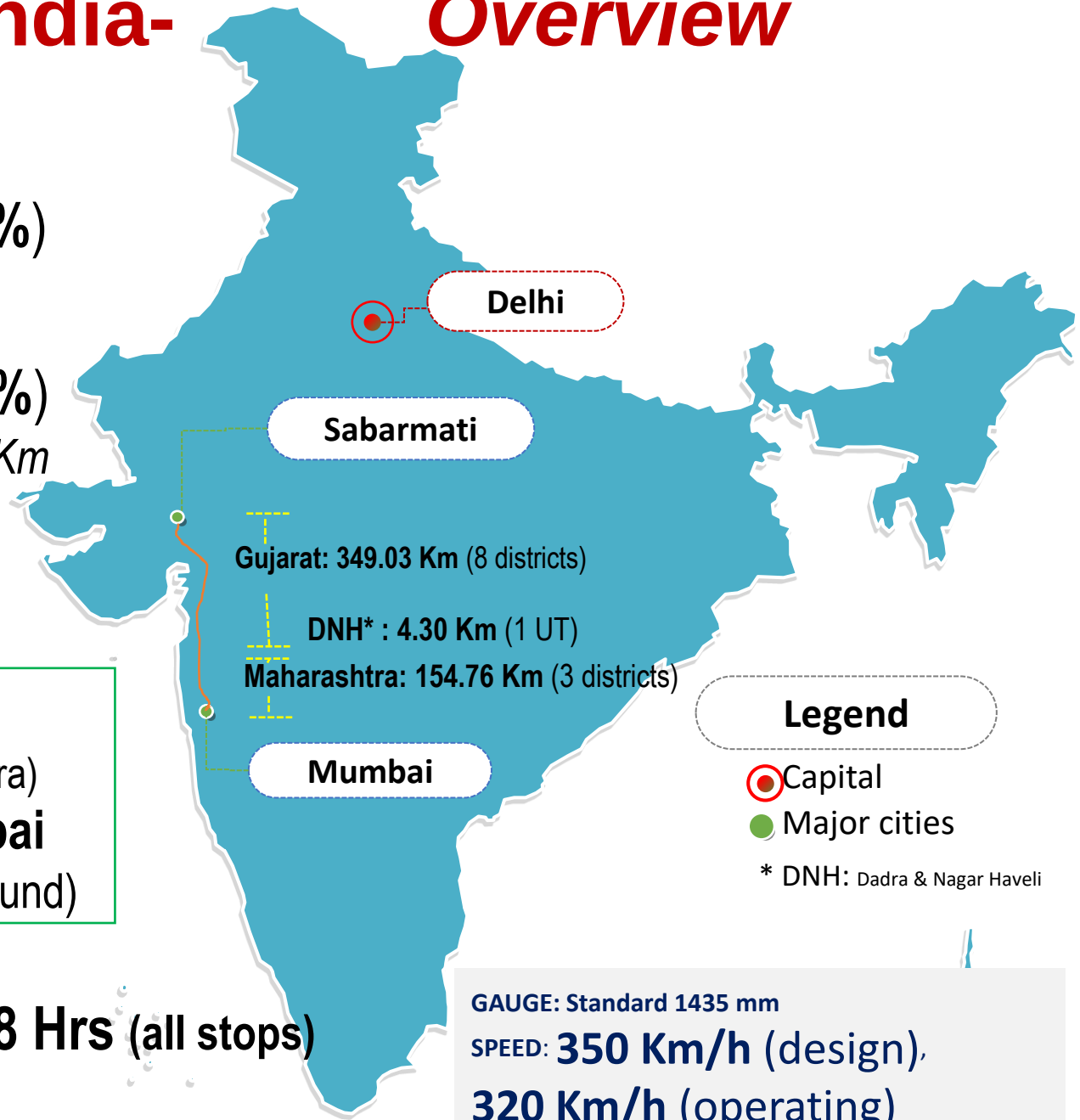
Total Length: 508.09 Km



- **460.3 Km** Viaducts (**90.6%**)
- **9.22 Km** Bridges (**1.8%**)
- **25.87 Km** Tunneling (**5.1%**)
  (Longest Tunnel: 21 Km with 7 Km undersea)
- **12.9 Km** Cut/Fill (**2.5%**)

Stations: 12 (8 in Gujarat & 4 in Maharashtra)
All elevated except Mumbai (underground)

Travel Time:
2.07 Hrs (limited Stops) **2.58 Hrs** (all stops)



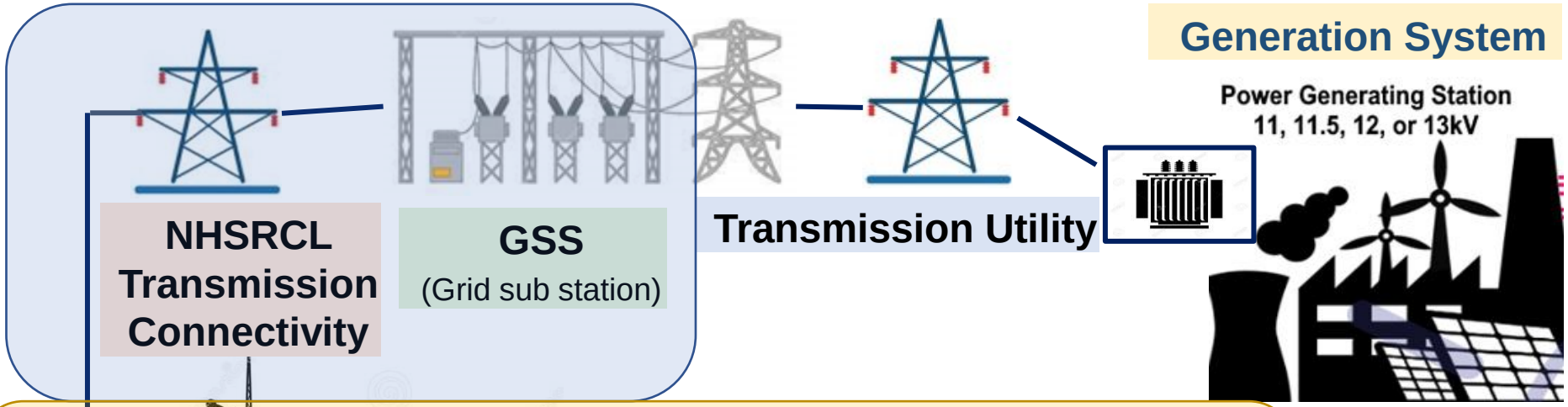
GAUGE: Standard 1435 mm
SPEED: **350 Km/h** (design),
320 Km/h (operating)

National High Speed Rail Corporation Ltd.- *Overview*

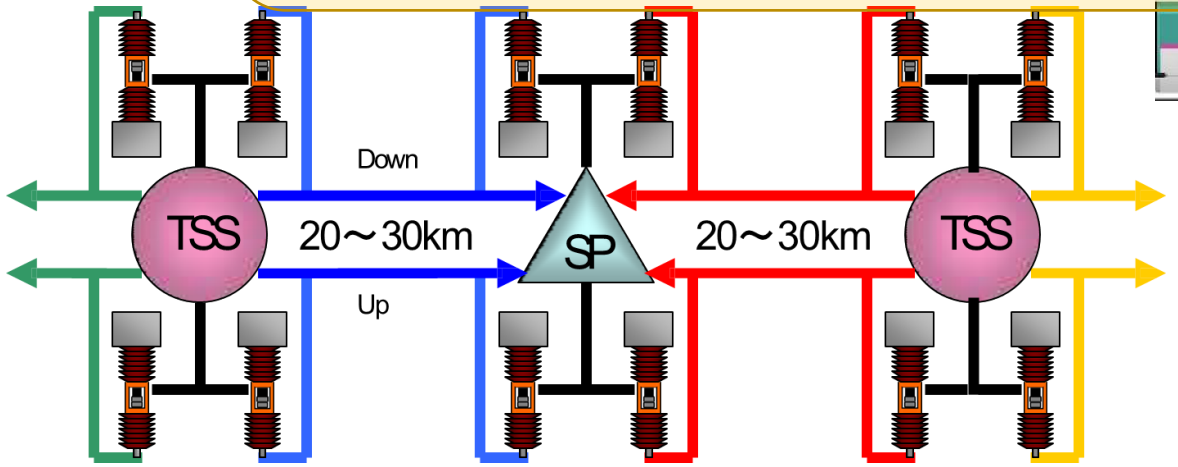
- National High Speed Rail Corporation Limited (NHSRCL), a Government company, Incorporated in 2016, for implementing the Mumbai-Ahmedabad High Speed Rail (MAHSR) Project.
- Joint ownership of Government of India and participating State Governments (i.e Gujarat & Maharashtra)
- Corporate Office in Delhi and
- Project Offices in Ahmedabad, Vadodara, Surat, Palghar/ Boiser and Mumbai for executing the Project.
- NHSRCL also preparing Detailed Project reports of seven more HSR corridors in India

Overview of *Traction Power Supply (PS) System*

TSS Main (Traction sub station)	**12**
TSS Depot	**2**
SP (Sectioning post)	**11**
SSP (sub Sectioning post)	**19**
ATP (Auto transformer post)	**1**



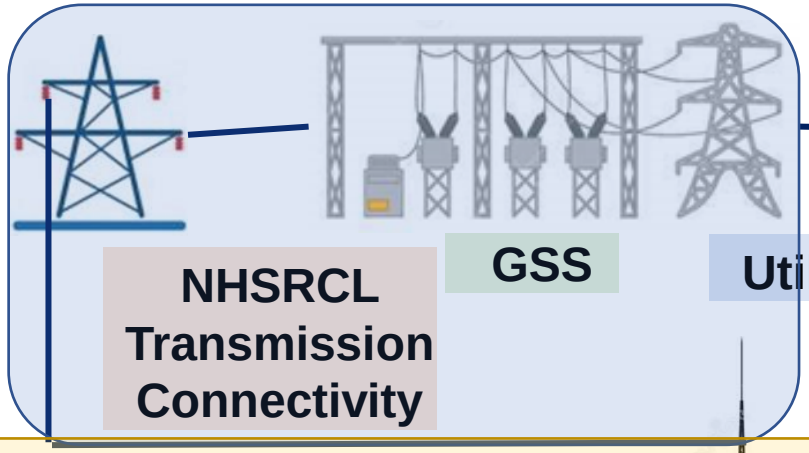
SCADA in OCC
(Remote control of Power supply system)



TRAIN OPERATION	Year 0	Year 30
Coaches	10	16
Rakes	24	71
per day/dir.	35	105

Overview of *Distribution Power Supply System*

Type of DSS (Distribution sub stations)	*No.*
DSS	16
Int. DSS	12
Minor DSS (≥ 500 kVA)	11
Minor DSS (< 500kVA)	26
Wayside DSS	155

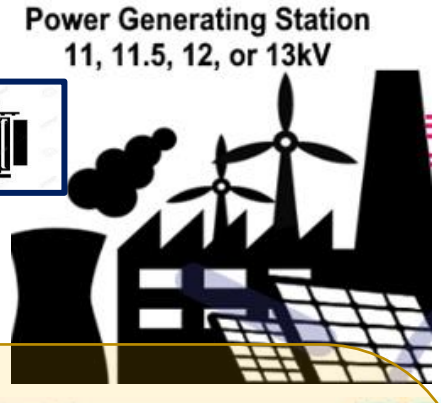


NHSRCL Transmission Connectivity

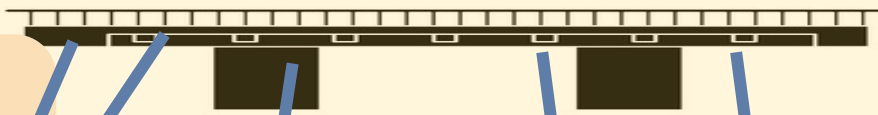
GSS

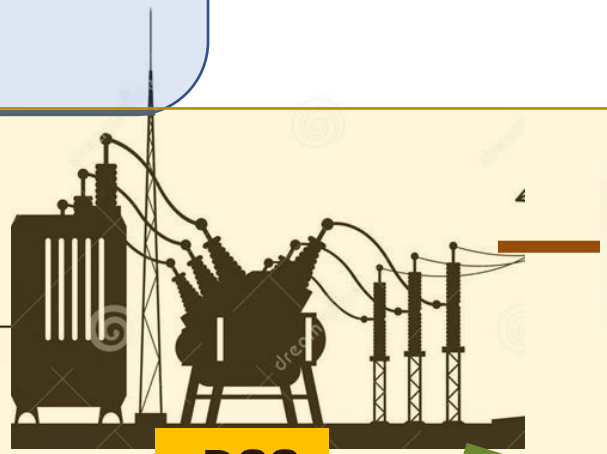
Utility Trans. Sys

Generation System



11 KV Line along Viaduct/ Tunnel, input to all other DSS





DSS

Depot Machine, E&M loads, OCC

Tunnel Eqpt
a. Tunnel Lighting, pump
b. Outlet for maint.
c. Tunnel Disconnector

Disaster Prevention
a. Wayside Seismometer
b. Anemometer
c. Rail Thermometer

Intermediate DSS

Sig/Tele Eqpt between station (through IDSS)

Wayside Eqpt
a. Outlet for maintenance
b. Maintenance Depots
c. Lighting for maintenance.
d. CCTV Camera

Stations: Lift, Escalator, AC, Fire Fighting Eqpt, Ventilation, Smoke Exhaust, Plumbing, Light etc

Sig/Tele Eqp at Station

Railway Station

Power Supply Systems- *Status & Plans*

Traction (Basic Design) *Distribution*

Completed:
Assessment of TSS load, spacing based on Simulation study (RTRI), ratings
Finalised: Standards, Equipment types

Completed:
Assessment of non traction loads based on Shinkansen experiences, ratings
Finalised: Standards, Equipment types

Traction (Power Sourcing Works) *Distribution*

Completed: Joint surveys, Load flow studies, connectivity granted - all substations

Works in progress: GSS augmentation, Transmission line , Land (in few cases)

High Speed Railway (Power supply Works)

Execution method is under advance stage of discussion and physical works are expected to commence in 2022-23.

Power Supply Systems- *Power Sourcing*

Traction Sub Station (TSS)		Type of incoming line	Distribution Sub Station (DSS)		Type of incoming Line
Location	*Receiving Voltage*		*Location*	*Receiving Voltage*	
Mumbai	110 kV	3 Ph X 2 (UG)	Mumbai	33 kV	3 Ph X 2 (UG)
Thane Depot	220 kV	3 Ph X 2 (OH)	Thane Drainage-1	22 kV	3 Ph X 2 (UG)
Thane	220 kV	3 Ph X 2 (OH)	Thane Drainage-2	22 kV	3 Ph X 2 (UG)
Virar	220 kV	3 Ph X 2 (OH)	Thane	22 kV	3 Ph X 2 (UG)
Boisar	132 kV	3 Ph X 2 (OH)	Virar	22 kV	3 Ph X 2 (UG)
Vapi	220 kV	3 Ph X 2 (OH + UG)	Boisar	33 kV	3 Ph X 2 (UG)
Bilimora	220 kV	3 Ph X 2 (OH + UG)	Vapi	66 kV	3 Ph X 2(OH + UG)
Surat	220 kV	3 Ph X 2 (OH)	Bilimora	66 kV	3 Ph X 2 (UG)
Bharuch	220 kV	3 Ph X 2 (OH)	Surat	66 kV	3 Ph X 2 (UG)
Vadodara	132 kV	3 Ph X 2 (OH)	Bharuch	66 kV	3 Ph X 2 (OH + UG)
Anand	220 kV	3 Ph X 2 (OH)	Vadodara	66 kV	3 Ph X 2 (UG)
Mahmedabad	220 kV	3 Ph X 2 (OH)	Anand	66 kV	3 Ph X 2 (OH + UG)
Ahmedabad	220 kV	3 Ph X 2 (OH + UG)	Ahmedabad	66 kV	3 Ph X 2 (UG)
Sabarmati/Depot	66 kV	3 Ph X 2 (OH + UG)	Sabarmati	66 kV	3 Ph X 2 (UG)
UG-Under Ground & OH-Over Head (Transmission Line)			Sabarmati OCC	66 kV	3 Ph X 2 (UG)

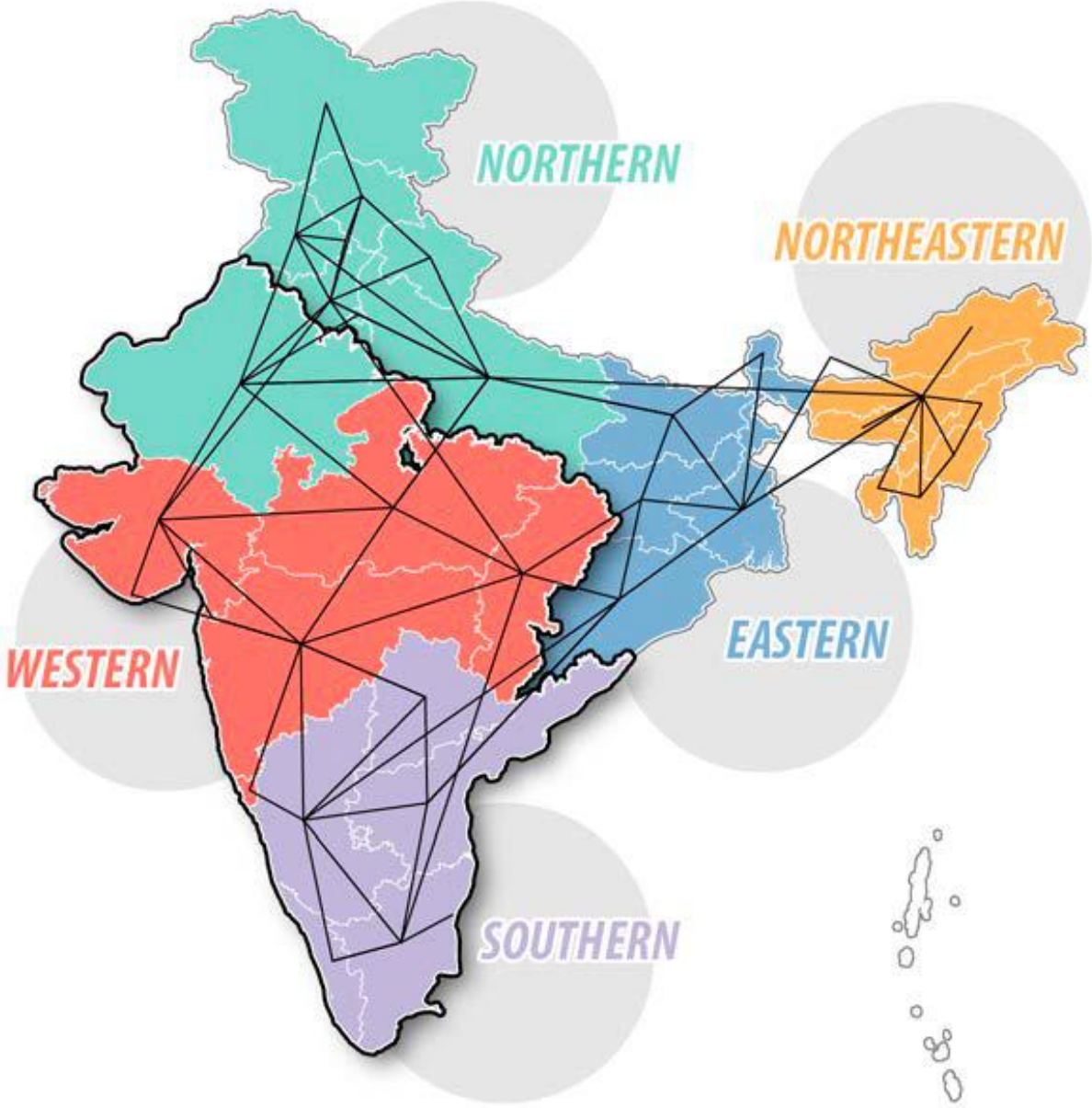
Stable power supply: *Incoming power*

❑ **India Power Grid Network:**

- is presently demarcated into five regional grids i.e. NR, SR, WR, ER & NER.
- All regional grids connected back to back synchronously to form **”One Nation-One Grid”.**
- ***MAHSR Project lies in the Western Grid.***

❑ **Western Grid is one of the most stable & reliable:** Grid performance, quality of power **data** (Voltage, frequency deviation etc) regularly published on WRLDC website confirms above

- ***MAHSR Power Supply is expected to be stable, reliable and good quality***

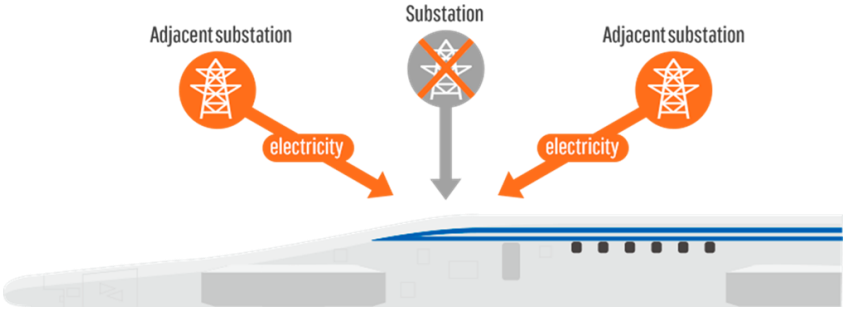


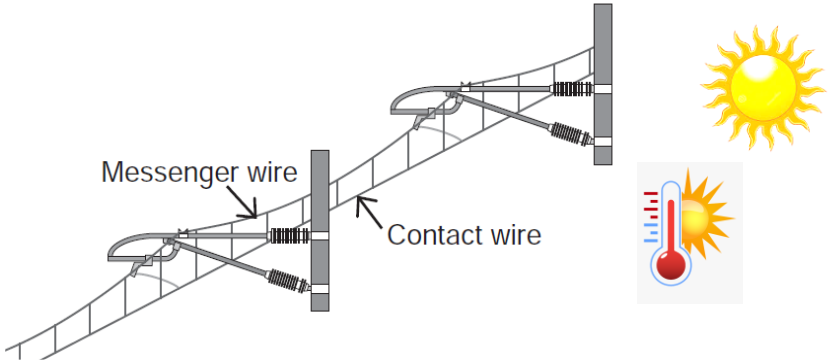
Five Operating Regions of the Indian Electricity Grid

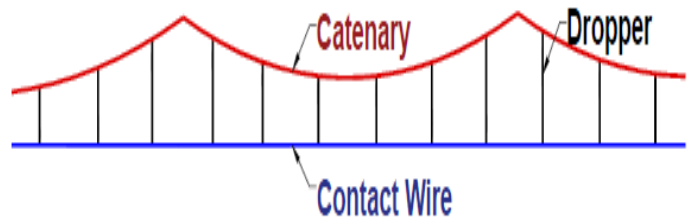
Stable power supply: *Design features*

1. System Design -worst case scenarios

- Peak projected traffic under worn out contact wire and at maximum ambient (55 deg C) throughout.
- Outage of both transformer in a TSS

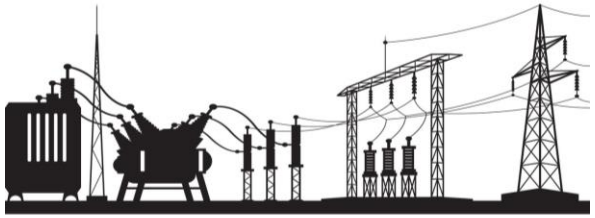






2. Redundancies related to Incoming Power Supply

- Power Supply at EHV Voltage level i.e. 132 kV or 220 kV to TSS; & at Transmission voltages i.e 33 kV, 66 kV etc. to DSS. EHV & Transmission grids are very reliable
- Two Independent circuits from GSS.
- Double Circuit Network meeting N-1 contingency criteria



(N-1 criterion: system that is able to withstand at all times an unexpected failure or outage of a single system component (e.g failures of single lines, transformers, generation plants, large loads, etc.)

Stable power supply: *major design features*

Redundancy at Equipment Level

- Traction Transformers in hot-standby mode suitable to feed independently both UP & DN line.
- Redundant AT Feedings bays.
- Major equipment such as Changeover switch, CB, Auxiliary transformer etc. are redundant.

Redundant & reliable Auxiliary AC & DC control supply

- 2 Nos. of Operating T/F (OT) providing redundancy in auxiliary AC supply.
- Third back up arrangement for auxiliary AC supply from the 11 kV distribution line in case both OT's are under outage.
- Redundancy in Battery control panel for ensuring DC control supply.

Redundancy in Protection & interlock systems

- Redundancy of relays and connections.
- Three Level control Hierarchy Level (equipment, panel and OCC).
- Protection interlock ensured through hard & soft logics.

Power Supply System (MAHSR)- *Challenges*

- **Matching the completion of Power sourcing works with the execution & completion of HSR power supply works (TSS, DSS & OHE Works etc.)**
- **Indigenous sourcing of major equipment under “Make in India”**

Thank you