



Training Program  
on

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# BUILDING RESILIENCE IN POWER SECTOR

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For Engineers  
of  
Energy and Petrochemicals Department, GoG

Date- 29-30 July 2024  
Venue: GIDM, B/h PDEU, Raysan, Gandhinagar,  
Gujarat



## 1. Background

Electricity falls under the Concurrent list of the Seventh Schedule of the Constitution of India, mandating both the Union Government and State Government to legislate on the matter. Following Independence, the sector was predominantly governed by State governments through the State Electricity Boards (SEB) created under the Electricity Act of 1948. The SEBs were tasked to enhance transmission infrastructure, increase power generation, and improve electricity access across the country.

Following the opening of the economy in 1991 and subsequent reforms in the electricity sector, independent regulatory commissions were established at the state level. The commissions were tasked to regulate the tariff for the Generation, Transmission and Distribution Companies within their jurisdiction. Close to 20 years of having a regulated regime since the implementation of the Electricity Act 2003.

### Gujarat Power Sector Scenario

Key data of Gujarat Power Sector is mentioned below:

S.No.	Key parameters	2022-23
1	Total Installed Capacity	40137 MW
2	Total Generation	129327 MU
3	Electricity Consumption	106349 MU
4	Per Capita Consumption (KWH)	2283 Units

Govt./Private Sector Organizations working in Power Sector is mentioned below:

S.No.	Profile	Name of PSU/Company
1	Policy	Energy & Petrochemical Department
2	Regulations	Gujarat Electricity Regulatory Commission
3	Supervision, Co-ordination and facilitation	Gujarat Urja Vikas Nigam Limited (GUVNL)
4	Power Generation	Gujarat State Electricity Corporation Limited (GSECL) Torrent Power Limited (TPL)
5	Transmission	Gujarat Energy Transmission Corporation Limited (GETCO)
6	Power distribution	<ul style="list-style-type: none"><li>Dakshin Gujarat Vij Company Limited (DGVCL)</li><li>Madhya Gujarat Vij Company Limited (MGVCL)</li><li>Paschim Gujarat Vij Company Limited (PGVCL)</li><li>Uttar Gujarat Vij Company Limited (UGVCL)</li><li>Torrent Power Limited (TPL)</li><li>MPSEZ Utilities Limited (MUL) [For Mundra SEZ Only]</li><li>Jubilant Infrastructure Ltd. (JIL) [Ishwaria SEZ, Bharuch Only]</li></ul>

		<ul style="list-style-type: none"> <li>Deendayal Port Trust (DPT) [Kandla Only]</li> <li>AspenPark Infra Vadodara Private Limited (AIVPL) [Waghodia SEZ, Vadodara Only]</li> </ul>
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Details regarding Power Sector Assets in Gujarat

S.No.	Details	No. of Assets
1	Power Stations	24
2	Sub-Stations	2176
3	Transmission lines	67601Ckm
4	No of Consumers	1,38,44,146

## 2. Understanding Risk in Power Sector

### 2.1 Natural Hazards and NATECH:

Gujarat is prone to various natural and human induced hazards like Earthquake, Cyclone, Floods and Industrial & Chemical Accidents. Natural hazards, such as earthquakes, floods or storms, can initiate events which may challenge the safety and operation of hazardous installations and trigger an accident (NATECH). Many past hazards have caused major damage to installations resulting in loss of lives, health effects, environmental pollution, and economic losses. During a natural hazard, three main types of incidents can lead to system breakdowns: transmission and distribution grid failure, generation plant failure, and fuel and maintenance supply chain failures

Type	Earthquake	Cyclone	Flood	Tsunami	Wildfire	Drought	Extreme Heat
Thermal plants	High	High	Medium	High		High	Medium
Hydropower plants	High	Low	Medium	Low		High	Medium
Nuclear plants	High	Medium	Medium	High		High	Medium
Solar (PV)	Low	High	Medium	Medium		Medium	Very low
Wind	High	Medium	Low	Medium		Very low	Very low
T&D lines	Medium	High	Low	Medium	High	Medium	Medium
Substations	High	High	High	Medium	High	low	Medium

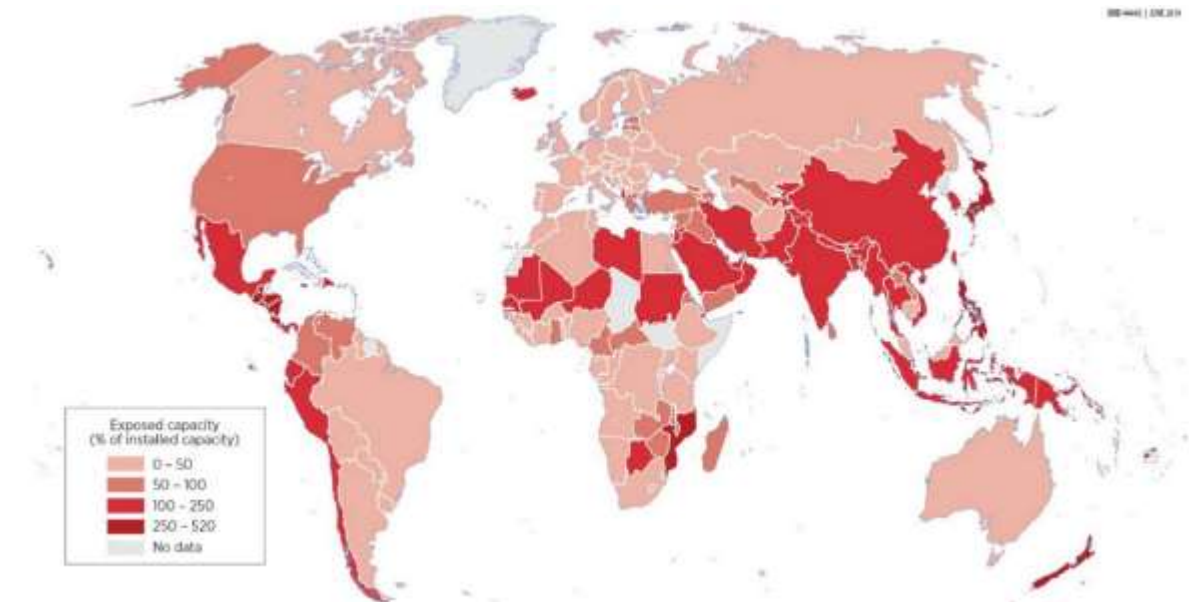
### 2.2 Energy demand

In last decade the country has faced severe heatwaves, pushing the demand for electricity. Surge in economic activities post COVID-19 lockdown has increased the demand for electricity. The summer of 2023 has recorded most number of heat days in a decade. Such unprecedented heat has surged the demand for AC units and water coolers. If the no. of heat days continues to increase in the coming

years, then it would pose a high risk to the grid and distribution networks and may result in blackouts or frequent power cuts.

### 2.3 Climate Change

Several climate change-induced phenomena are likely to increase power sector vulnerability. With increased drought frequency and higher temperatures, the efficiency of thermal power plants is likely to decrease. Research suggests that a 1°C temperature increase could reduce power output by 0.45 to 0.8 percent. Changes in weather patterns and the frequent occurrences of extreme weather events will have serious consequences for the country. Going forward, the most pronounced feature of climate change will be the increase in mean temperatures and the greater intensity of rainfall. These events will, directly and indirectly, impact the entire value chain of the power sector



*Global multi-hazard power generation infrastructure exposure*

### 2.4 Human induced hazards

Human induced hazards may result from technological and human behavioral aspects. This may include defects in materials, poor workmanship or design, fires from system fault, technology failure, unpredictable load shifts, aging infrastructure, accidents, incompetency, bad actors, unavailability of risk management plan etc.

## 3. Risk Governance in Power Sector

In exercise of powers, conferred by Section 37 of the Indian Electricity Act 1910, Electricity Rules were made by Central Electricity Board. These Rules have been saved in the Electricity Act 2003 as given in Section 185 of the Act. It shall continue to be enforced till regulation/rules under **Section 53 of the Electricity Act 2003** are made. There are 143 rules in eleven chapters. In Electricity Rules necessary efforts are made to follow basic principles of safety and installation. These are- design and

manufacture of basic components, planning and design of tailor made systems, installation, operation and maintenance of electricity.

**National Disaster Management Authority (NDMA)** under Govt. of India enacted National Disaster Management Act-2005 which talks about integration of measures for prevention of disasters and mitigation in development plans and projects

**Gujarat State Disaster Management Act -2003** talks about developing prevention and mitigation strategies and ensuring proper training of personnel, capacity building and data collection.

**Sendai Framework for Disaster Risk Reduction (SFDRR)** emphasize on risk prevention and reduction measures in physical infrastructure and critical infrastructure through disaster resilient design and construction, retrofitting and nurturing a culture of maintenance.

Addressing climate change as one of the drivers of disaster risk, while respecting the mandate of the **United Nations Framework Convention on Climate Change (UNFCCC)**, represents an opportunity to reduce disaster risk in a meaningful and coherent manner throughout the interrelated intergovernmental processes

**United Nations Conference on Sustainable Development**, held in 2012, entitled “The future we want”, called for disaster risk reduction and the building of resilience to disasters to be addressed with a renewed sense of urgency in the context of sustainable development and, as appropriate, to be integrated at all levels. The Conference also reaffirmed all the principles of the Rio Declaration on Environment and Development

Acts & Rules	Policy	National & International Frameworks
<ul style="list-style-type: none"><li>• National Disaster Management Act-2005</li><li>• Gujarat State Disaster Management Act - 2003</li><li>• Electricity Act 2003</li><li>• India Electricity Rules 1958</li></ul>	<ul style="list-style-type: none"><li>• National Electricity Policy 2021</li><li>• Power Generation Policy 2009</li></ul>	<ul style="list-style-type: none"><li>• Sendai Framework for Disaster Risk Reduction (SFDRR)</li><li>• Paris Climate Agreement</li><li>• Sustainable Development Goals</li><li>• PM 10 Point Agenda</li></ul>

#### 4. Building Resilience in Power Sector

Improving power sector resilience requires systematically identifying and addressing vulnerabilities through proactive resilience planning. Power sector resilience planning can be done at many geographic scales and should be included within the existing power sector planning processes in place, such as integrated resource planning or power development planning.

<b>Risk Assessment and Risk Communication</b>	<b>Strengthening Risk Governance</b>	<b>Risk Management through Preparedness and Capacity Building</b>
<ul style="list-style-type: none"> <li>• Hazards/risk data and assessment</li> <li>• Vulnerability/capacity and impact data and assessment</li> <li>• Scientific and technical capacities and innovation</li> </ul>	<ul style="list-style-type: none"> <li>• Policy, planning, priorities and commitment</li> <li>• Legal and regulatory systems</li> <li>• Integration with development policies and planning</li> <li>• Integration with emergency response and recovery</li> <li>• Institutional mechanisms, capacities and structures</li> <li>• Allocation of responsibilities</li> <li>• Partnerships</li> <li>• Accountability</li> </ul>	<ul style="list-style-type: none"> <li>• Public awareness, knowledge and skills</li> <li>• Information management and sharing</li> <li>• Education and training</li> <li>• Cultures, attitudes, motivation</li> <li>• Learning and research</li> </ul>

## 5. Capacity building programme for Building Resilience in Power Sector

The target group for developing the capacities in power sector is mentioned below:

<b>S.No.</b>	<b>Department</b>	<b>Target Groups</b>
1	Gujarat Electricity Regulatory Commission	<ul style="list-style-type: none"> <li>• Dy. Director</li> <li>• Assistant Director</li> <li>• Executive</li> </ul>
2	Gujarat Urja Vikas Nigam Limited (GUVNL)	<ul style="list-style-type: none"> <li>• Chief Engineer</li> <li>• Addl. Chief Engineer</li> <li>• Superintending Engineer</li> <li>• Executive Engineer</li> <li>• Dy. Superintendent</li> <li>• Dy. Engineer</li> <li>• Junior Engineer</li> </ul>
3	Gujarat State Electricity Corporation Limited (GSECL)	
4	Gujarat Energy Transmission Corporation Limited (GETCO)	
5	<ul style="list-style-type: none"> <li>• Dakshin Gujarat Vij Company Limited (DGVCL)</li> <li>• Madhya Gujarat Vij Company Limited (DGVCL)</li> <li>• Paschim Gujarat Vij Company Limited (DGVCL)</li> <li>• Uttar Gujarat Vij Company Limited (DGVCL)</li> <li>• Torrent Power Limited (TPL)</li> <li>• MPSEZ Utilities Limited (MUL) [For Mundra SEZ Only]</li> </ul>	

	<ul style="list-style-type: none"> <li>• Jubilant Infrastructure Ltd. (JIL) [Ishwaria SEZ, Bharuch Only]</li> <li>• Deendayal Port Trust (DPT) [Kandla Only]</li> <li>• AspenPark Infra Vadodara Private Limited (AIVPL) [Waghodia SEZ, Vadodara Only]</li> </ul>	
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## 6. Objective

The programme has following objectives:

- Develop understanding on Risk, Hazards, Exposure, Vulnerability and Capacity
- Raise awareness about potential risks in Power sector
- Enhance the ability of Engineers to develop plan of action for resilience in power infrastructure (Power Plant, Power Station, transformers, transmission line, transmission towers, HT/LT Lines, poles etc.)
- Encourage development of disaster risk management plan for reducing risks in power plants
- Provide understanding on how cascading hazards affects the power assets

## 7. Pre-requisite

There are no pre-requisites for this training course, but prior knowledge on basics of Disaster Risk Management may be beneficial.

## 8. Expected Learning Outcome

- Participants understand the basics of disaster risk management
- Participants can develop action plan on resilience of power infrastructure for their respective districts

## 9. Targeted Participants

The course is targeted for the Junior Engineer, Dy. Engineer, Dy. Superintendent, Dy. Engineer, Executive Engineer and Superintending Engineer

## 10. Training Pedagogy

The training will be held at Seminar Hall, GIDM, facilitated by Subject Matter Experts (SME). The training will include active learning techniques such as presentations, group discussions, interactive exercises, case studies, simulations, exposure visits and hands on experience which will encourage participants to engage actively with the training content

Further, quizzes, tests and skill demonstration will also be included in the program for monitoring learners' progress, identifying areas for improvement, and reinforcing learning outcomes.

## 11. Training Certificate

Certificate of participation will be given to participants who attend all the sessions during the 2-days training program

## 12. Schedule of Programme

The tentative schedule of the proposed capacity building programme is mentioned below:

Day – 1: 29 <sup>th</sup> July 2024			
Time	Session	Session Details/ Objectives	Resource
8.30-9.30		<b>Breakfast</b>	
9.30-10.00	Registration	<ul style="list-style-type: none"> <li>Online registration of participants</li> <li>Training kit distribution</li> <li>Facility briefing</li> <li>Safety briefing</li> </ul>	GIDM
10.00 – 10.30	Pre-Test & Introduction of Participants	<ul style="list-style-type: none"> <li>15 Question online Test on DRR</li> <li>Establishment of Ground rules</li> <li>Introduction of participants</li> </ul>	GIDM
10.30-10.45	About GIDM	At the end of the session participants would be able to understand: <ul style="list-style-type: none"> <li>History &amp; Establishment of GIDM</li> <li>Governance mechanism</li> <li>Core areas of GIDM</li> <li>Programs and Achievements</li> </ul>	GIDM
10.45-11.00		<b>Tea break</b>	
10.45-11.45	Basic of Disaster Risk Management	At the end of the session participants would be able to understand: <ul style="list-style-type: none"> <li>Understanding 'Disaster Risk' through Hazards, Exposure, Vulnerability and Capacity components</li> <li>Policy &amp; Governance in DRM</li> <li>Key principles of Disaster Risk Reduction (DRR)</li> <li>Emerging trends in disaster management and infrastructure resilience</li> </ul>	GIDM
11.45-12.00		<b>Tea break</b>	
12.00–13.00	Understanding on Creating Resilient Power Systems	At the end of the session participants would be able to understand: <ul style="list-style-type: none"> <li>Resilient Infrastructure-Concepts &amp; trends</li> <li>Identifying potential hazards and risks to power infrastructure</li> </ul>	CDRI



		<ul style="list-style-type: none"> <li>Assessing vulnerabilities in existing infrastructure</li> <li>National &amp; international policies promoting resilient power systems</li> </ul>	
<b>13.00-14.00</b>	<b>Lunch break</b>		
<b>14.00-15.30</b>	<b>Strengthening Resilience in Power Facilities</b>	<p>At the end of the session participants would be able to understand:</p> <ul style="list-style-type: none"> <li>Effect of hazards on power generation facilities</li> <li>Risk and Vulnerability assessment of critical assets</li> <li>Hazard resistant and climate adaptive design of power stations for building resilience</li> <li>Safe operation &amp; maintenance of power stations</li> <li>Case studies and good practices in resilient power generation facilities</li> </ul>	<b>L&amp;T-Sargent &amp; Lundy Limited</b>
<b>15.30-15.45</b>	<b>Tea break</b>		
<b>15.45-16.45</b>	<b>Case study: Issues &amp; challenges to Power Sector during Cyclone Biporjoy</b>	<p>At the end of the session participants would be able to understand:</p> <ul style="list-style-type: none"> <li>Overview of Cyclone Biporjoy</li> <li>Preparedness measures taken by PGVCL</li> <li>Response of PGVCL during Cyclone Biporjoy</li> <li>Good practices undertaken by PGVCL</li> </ul>	<b>PGVCL</b>
<b>16.45-17.45</b>	<b>Fire Safety Hands on Exercise</b>	<p>At the end of the session participants would be able to understand:</p> <ul style="list-style-type: none"> <li>Types of Fire</li> <li>Procedure to use fire extinguisher</li> <li>Fire risk assessment</li> <li>Hands on use of fire extinguisher</li> </ul>	<b>Shri. SM Sheikh, Instructor, GSFA</b>
<b>Day -2: 30<sup>th</sup> July 2024</b>			
<b>9.00-10.00</b>	<b>Breakfast</b>		
<b>10.00-11.00</b>	<b>Regulatory strategies for Enhancing Resilience in the power Sector: The case of Gujarat Electricity Regulatory Commission (GERC)</b>	<p>At the end of the session participants would be able to understand:</p> <ul style="list-style-type: none"> <li>Introduction to GERC and regulatory framework</li> <li>Tariff structures and Incentives for Resilient Infrastructure</li> <li>Regulatory approaches to Disaster preparedness and Response</li> <li>Impact of GERC's policies on public policy formulation in energy resilience</li> </ul>	<b>Shri Anand Kumar, Professor of Practice, IIT-Gandhinagar</b>

11.00-11.15	<b>Tea break</b>		
11.15-12.15	<b>Case study: Issues &amp; challenges to Power Sector during Banaskantha Floods 2017</b>	At the end of the session participants would be able to understand: <ul style="list-style-type: none"> <li>• Overview of Banaskantha Floods</li> <li>• Preparedness measures taken by UGVCL</li> <li>• Response of UGVCL during Banaskantha Floods</li> <li>• Good practices undertaken by UGVCL</li> </ul>	<b>UGVCL</b>
12.15-13.15	<b>Resilient Power Pathways for sustainable future</b>	At the end of the session participants would be able to understand: <ul style="list-style-type: none"> <li>• Effect of hazards on transmission towers and lines</li> <li>• Planning &amp; development of transmission line in vulnerable areas</li> <li>• Hazard resistant and climate adaptive design of transmission towers</li> <li>• Operation &amp; maintenance of transmission lines</li> </ul>	<b>TBD</b>
13.15-14.00	<b>LUNCH break</b>		
14.00-15.00	<b>Development of Disaster Risk Management Plan</b>	At the end of the session participants would be able to understand: <ul style="list-style-type: none"> <li>• Importance &amp; objectives of DRM for electricity utilities</li> <li>• Identification and assessment of risks specific to power infrastructure</li> <li>• Strategies to mitigate risks and vulnerabilities in power operations</li> <li>• Emergency response plans for power utilities</li> <li>• Integrating BCP with DRM strategies</li> <li>• Monitoring of DRM Plan</li> </ul>	<b>GIDM</b>
15.00-15.15	<b>Tea break</b>		
15.15-16.45	<b>Group Activity- Developing Resilience Action Plans</b>	At the end of the session participants would be able to understand: <ul style="list-style-type: none"> <li>• Participants work in groups to develop resilience action plans for hypothetical situation</li> <li>• Presentation of Action Plans</li> </ul>	<b>GIDM</b>
16.45-17.00	<b>Valedictory Session</b>	<ul style="list-style-type: none"> <li>• Post-test</li> <li>• Feedback</li> <li>• Certificate distribution</li> </ul>	<b>GIDM</b>

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