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GOVERNMENT OF INDIA
विद्युत मंत्रालय
MINISTRY OF POWER
केन्द्रीय विद्युत प्राधिकरण
CENTRAL ELECTRICITY AUTHORITY
मानव संसाधन विकास प्रभाग
HUMAN RESOURCE DEVELOPMENT DIVISION

विद्युत उत्पादन के क्षेत्र में प्रशिक्षण संस्थानों की मान्यता के लिए और इंजीनियरों, पर्यवेक्षकों और तकनीशियनों के प्रशिक्षण पाठ्यक्रम के विवरण के लिए मार्गदर्शी सिद्धांत

Guidelines for Recognition of Training Institutes in the field of Generation of Electricity including details of Training Curriculum for Engineers, Supervisors and Technicians

January, 2024

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CHAPTER-I OBJECTIVE AND SCOPE

- 1. Background:** The clause (g) of section 73 of the Electricity Act, 2003 mandates **Central Electricity Authority (“CEA”)** to promote measures for advancing the skills of persons engaged in the electricity industry. Accordingly, the provisions for training for the personnel engaged in the operation and maintenance of generating station have been made mandatory under the **Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023 (hereinafter to be referred as “Safety Regulations”)**. The provisions have been made under regulation 7 of the Safety Regulations for mandatory training of the personnel engaged in operation and maintenance of generating station. As per the Safety Regulations, 2023 the Authority shall issue guidelines for the training for operation and maintenance of generating station within six months of the notification of these regulations.

The curriculum for the training of personnel engaged in Operation & Maintenance of generating station was the part of Central Electricity Authority (Measures relating to Safety and Supply) Regulations, 2010. The same needed to be updated and made part of these guidelines.

Accordingly, **Guidelines for Recognition of Training Institutes for Power Sector in the field of Generation as per CEA (Measures Relating to Safety & Electric Supply) Regulations, 2023 along with updated Curriculum is detailed hereunder .**

- 2. Objective:** As per the requirement of **Safety Regulations**, the personnel engaged for the Operation & Maintenance of generating station shall require to be imparted statutory training from the institutes recognized by the Central Electricity Authority (CEA) for ensuring safe, secure, reliable and economic operations of the generating station.

3. Scope:

- (i) These guidelines include the procedure and criteria for recognition of the training institutes for imparting training to personnel engaged to operate or undertake maintenance of generating station.
 - (ii) These guidelines also include the curriculum to be followed by the training institutes for training of Engineers, Supervisors and Technicians engaged to operate or undertake maintenance of generating station.
- 4.** (i) In exercise of the power conferred to the Authority under section 177 read with the section 53 of the Electricity Act, 2003, the Central Electricity Authority vide notification no. No. CEA-PS-16/1/2021-CEI Division dated 08.06.2023 has notified the Safety Regulations, 2023 which provide for mandatory training for the personnel engaged for the operation & maintenance of generating station.
- (ii) The Regulation 7 of the Safety Regulations provide the details with regard to the mandatory requirement for training for the personnel engaged for the operation & maintenance of generating station and the mandatory requirement for the recognition of the training institute by the Authority which is reproduced as under:

7. Safety measures for operation and maintenance of generating station. – (1) The Engineers and Supervisors engaged or appointed to operate or undertake maintenance of any part or whole of a generating station shall hold degree or diploma in Engineering relevant to the electrical installations from a recognised institute or university.

(2) The Engineers and Supervisors engaged or appointed for operation and maintenance of generating station shall have successfully undergone the type of training as specified by the Authority in its guidelines issued under sub-regulation (4) from time to time, within two years from the date of engagement or appointment.

(3) *The Technicians to assist Engineers or Supervisors shall possess a certificate in appropriate trade, preferably with a two years course from an Industrial Training Institute recognised by the Central Government or the State Government and shall have successfully undergone the type of training as specified in sub-regulation (4), within two years from the date of engagement or appointment:*

Provided that the existing employees, as on the date of notification of these regulations, who are extending technical assistance to Engineers or Supervisors and do not have requisite qualification as mentioned in this regulation, shall have to undergo the training either from Power Sector Skill Council or from training institute recognised by the Authority for carrying out trade specific course as per the guidelines issued by the Authority and get certificate as mentioned above within two years from the date of notification of these regulations.

(4) *The Authority shall issue guidelines for the training for operation and maintenance of generating station within six months of the notification of these regulations:*

Provided that the duration and content of the training course shall be as specified in the guidelines.

(5) *The owner of every generating station shall arrange for training of personnel engaged or appointed to operate and undertake maintenance of the generating station from its own institute or any other institute recognised by the Authority or State Government as per the guidelines and shall maintain records of the assessment of these personnel issued by the training institute in the format prescribed in guidelines and such records shall be made available to the Electrical Inspector, as and when required.*

(6) *The certificate of recognition of the training institute under these regulations shall be displayed by the Institute on its website at home page.*

(7) *Notwithstanding anything contained in sub-regulation (4), the training syllabus may be customised by the owner of the generating station of capacity below 100 MW owning the training institute for the purpose of imparting training to its employees under intimation to the Authority.*

5. Category of Training Institutes:

(1) There shall be three Categories of training institutes in terms of Safety Regulations of CEA:

- i) Category-I for Engineers under sub regulation 7(2) of Safety Regulation 2023
- ii) Category-II for Supervisors under sub regulation 7(2) of Safety Regulation 2023
- iii) Category-III for Technicians under sub regulation 7(3) of Safety Regulation 2023

(2) All the training institutes of Central Sector to be recognised by the Authority, must have separate training facilities and modules for Engineers, Supervisors and Technicians in categories I, II and III respectively within six months of issuance of these guidelines. All the training institutes of State and Private Sector, may explore the possibilities for having separate training facilities and modules for Engineers, Supervisors and Technicians in categories I, II and III respectively.

6. Training Institutes to be Recognised by the Authority:

- (1) The training institutes owned wholly or partly by the Central Government/Central Power Sector Undertakings (CPSUs)/Central Government Organizations willing to offer training to personnel engaged to operate or undertake maintenance of generating station shall be recognized by Authority.

7. Training Institutes owned by State Government or Private Sector to be Recognised by the State Government or by the Authority:

- (1) The training institutes owned wholly or partly by the State Government/State Power Sector Undertakings/ State Government Organizations willing to offer training to personnel engaged to operate or undertake maintenance of generating station, shall be recognized by the Authority or by the respective State Government as per these guidelines.
- (2) The Training Institutes under the control of Private Power Sector Utilities or under any other Private Sector company, willing to offer training to personnel engaged to operate or undertake maintenance of generating station, shall be recognized by the Authority or by the respective State Government, where the institute is physically located , as per these guidelines.

CHAPTER-II

RECOGNITION OF TRAINING INSTITUTE BY AUTHORITY

8. Application by the training institute for Fresh recognition by the Authority:

- (1) The training institute can apply for recognition in the following fields:
 - (i) Thermal Generation
 - (ii) Hydro Generation
 - (iii) Renewable Energy Generation
- (2) The training institute shall apply to the Authority, furnishing the required information, for its recognition in the prescribed format enclosed (**Form A**), for last financial year, in these guidelines.
- (3) The following shall be the mandatory requirements for the recognition of training institute for Engineers, Supervisors and Technicians engaged for the Operation & Maintenance of generating station:
 - (i) The training institute shall have a full time Principal/Director and teaching staff.
 - (ii) There should be a separate building which shall be solely used for the purpose of training. The building shall either be owned by the institute or on lease. However, in case the building is on lease then the lease period shall be more than the period of recognition.
 - (iii) The training institute shall give an undertaking that on recognition for 3 years initially, the institute shall follow the curriculum as per these guidelines.
 - (iv) The training institute shall have the facilities of providing training on simulator and slide shows & multimedia etc. The training institute shall have institutional tie up for simulator training/labs/workshops, if not having in-house.
 - (v) The training institute shall score a least 60% in the evaluation criteria for getting its recognition from the Authority.
 - (vi) The training institute shall have CCTV facility at the examination hall for conducting the term end exam. The training institute may have tie up with independent agency for conducting the exam which shall have CCTV facility at the examination hall for conducting the exam.
 - (vii) The training institute shall have basic medical facilities and high speed internet facilities in its premises.
 - (viii) The budget provision and control of expenditure for training program shall be distinctly and exclusively earmarked for the institute.
- (4) The requisite fee for application for fresh recognition shall be levied from the training institute. The details regarding payment of fees shall be as per the fee schedule issued by the Central Electricity Authority from time to time.
- (5) On receipt of the complete application with information specified above, CEA shall examine the eligibility of the same and if the application is found to be eligible for recognition by Authority, the institute has to submit the above-mentioned fee to the Authority for processing the application for its recognition.
- (6) After receipt of the fee and complete application specified above, the team of CEA officers will make an assessment on the various aspects in accordance with laid down criteria/norms as specified in these guidelines by visiting the institute on a mutually agreed date.

9. Application by the Training Institute for Renewal of Recognition :

- (1) The training institute can apply for recognition in following fields:
 - (i) Thermal Generation
 - (ii) Hydro Generation
 - (iii) Renewable Energy Generation
- (2) The training institute shall apply four months before the expiry of the earlier recognition to the Authority for the renewal of its recognition furnishing the required information in the prescribed format enclosed (**at Form B**) for last three financial years separately.
- (3) The following shall be the mandatory requirements for renewal of recognition of training institute for Engineers, Supervisors and Technicians engaged for the Operation & Maintenance of Generating station :
 - (i) The training institute shall have a full time Principal/Director and teaching staff.
 - (ii) There should be a separate building which shall be solely used for the purpose of training. The building shall either be owned by the institute or on lease. However, in case the building is on lease then the lease period shall be more than the period of recognition.
 - (iii) The training institute shall have at least 2 faculties (Core/Empaneled/Guest) in relevant specialized topics/subjects of the curriculum given in these guidelines.
 - (iv) The training institute shall have the facilities of providing training on simulator and slide shows & multimedia etc. The training institute shall have institutional tie up for simulator training/labs/workshops, if not having in-house.
 - (v) The training institute shall score at least 60% in the evaluation criteria for getting its recognition from the Authority.
 - (vi) The training institute shall be conducting induction course as per the curriculum given in these guidelines.
 - (vii) The training institute shall have CCTV facility at the examination hall for conducting the term end exam. The training institute may have tie up with independent agency for conducting the exam which shall have CCTV facility at the examination hall for conducting the exam.
 - (viii) The training institute shall have basic medical facilities and high speed internet facilities in its premises.
 - (ix) The budget provision and control of expenditure for training program shall be distinctly and exclusively earmarked for the institute.
- (4) The requisite fee for application for renewal of recognition shall be levied from the training institute. The details regarding payment of fees shall be as per the fee schedule issued by the Central Electricity Authority from time to time.
- (5) On receipt of the complete application with information specified above, CEA shall examine the eligibility of the same and if the application is found to be eligible for renewal of recognition by Authority, the institute has to submit the above-mentioned fee to Authority for processing the application for renewal of recognition.
- (6) After receipt of the fee and complete application specified above, the team of CEA officers will make an assessment on the various aspects in accordance with laid down criteria/norms as specified in these guidelines by visiting the institute on a mutually agreed date.

- (7) The training institutes applying for renewal of recognition after the date of expiry of earlier recognition shall be treated as institute seeking for fresh recognition and shall be charged a fee same as that for fresh recognition as mentioned above.
- (8) The training institutes applying for renewal of recognition after the date of expiry of earlier recognition shall not be displayed in the list of training institutes recognized by CEA.

10. Application for recognition (Fresh / Renewal) of Training Institutes with multiple Fields of Training: The Training institute applying for Fresh or Renewal for recognition in more than one field amongst Load Despatch, Generation, Transmission and Distribution and also in more than one categories of Institutes, shall have to follow the following procedure provided that such fields of Training for all Categories of institutes are available in the Institute at same Location:

- (1) The Institute shall submit the required information in the prescribed format, i.e, in Form A for fresh recognition or Form B for renewal of recognition for each of such fields of training and also for such categories of Institutes as mentioned in the relevant Guidelines of CEA in a single application.
- (2) The Institute shall fulfil all the mandatory conditions and general conditions prescribed in such fields of training and also for such categories of Institutes as mentioned in the relevant Guidelines of CEA.
- (3) The requisite fee for the Fresh or Renewal of recognition of training institute shall be levied from the training institute. The details regarding payment of fees shall be as per the fee schedule issued by the Central Electricity Authority from time to time.
- (4) After receipt of the Application specified above, the Central Electricity Authority officer(s) shall make an assessment on the various aspects in accordance with laid down criteria/norms as specified in respective guidelines by visiting the institute on a mutually agreed date.

11. Parameters/Criteria for assessment of the training institute: The training institute shall ensure that all the requisite Infrastructure/Faculty/Course content /Budget are available, as far as possible, in their own training institutes.

I. Infrastructure:

Apart from Mandatory condition as mentioned above, it is preferable that the institute shall have following:

- (1) Minimum one classroom, seminar/conference hall/ auditorium, library.
- (2) Separate hostels for men and women with mess or there shall be institutional tie-up with other Institutes/utilities/facilities.
- (3) In-house simulator training facilities or there shall be institutional tie-up with other Institutes/utilities.
- (4) In-house Certification Exam Facilities or there shall be institutional tie-up with other Institutes/utilities.

- (5) Facilities for demonstration by static models, training resource unit supported with appropriate reprographic facilities, Audio-visual training aides including Computer Based Training (CBT) packages, Liquid Crystal Display (LCD)/ Light Emitting Diode(LED)/Video screen Slide and Overhead projectors, virtual reality, gamification, and e-learning platforms.
- (6) Recreation facilities, transport, Canteen, Laundry.

The training institutes shall ensure that the environment provided to the trainees is proper, clean & hygienic such that conducive environment prevails for the trainees while undergoing training at the institutes.

II. Organization and Staffing:

- (1) The training institute shall have a full time Principal/Director of appropriate level officer as described below:
 - (i) CPSU training institute shall be headed by an officer of Executive Director or equivalent level or above for category-I, General Manager (GM) or above for category-II & category-III.
 - (ii) State Sector institute shall be headed by a Chief Engineer or equivalent level officer for category-I, Superintending Engineer or above for category-II & category-III.
 - (iii) Private sector institute shall be headed by an officer having degree in MBA-HR with minimum relevant work experience of 18 years for category-I and 15 years for category-II and category-III.
- (2) The training institute shall have adequate number of regular in- house teaching staff in the field of generation in addition to the external faculty depending upon the scope and magnitude of the training institute.
- (3) During the training period, the trainees shall be under the administrative control of the head of the training institute.

III. Faculty

- (1) The faculties of the training institute shall have experience of minimum 5 years in the relevant areas of generation. Core Faculty shall also have undertaken at least one week training from an institute with all-India recognition in their area of knowledge at least once a year.
- (2) The faculties shall be familiar with latest instructional techniques and apply innovative means for administrating the training inputs.
- (3) The faculties getting salary from allocated budget of training institute shall be considered as core faculty of the training institute.
- (4) Besides Core Faculties, the training institutes may empanel faculties with relevant experience in Generation for delivering lectures/ imparting knowledge by using simulator.
- (5) Empaneled Faculties of an institute shall consist of the trainers who have delivered at least five lectures in a financial year in the institute.

- (6) The external (Guest) faculties shall be specialized in the subject with adequate experience on the topic in which lecture has to be delivered.

IV. Training Methodology

- (1) Training shall be imparted in Classroom through lectures and talks of eminent speakers, group discussion in conference hall, visits to manufacturing units, generating stations, control room, simulator and on-job training.
- (2) The minimum batch size for any classroom training programme is 10 for considering the respective training programme in the evaluation process.
- (3) The trainee shall be imparted practical training on the site (or equivalent site), where the trainee is expected to be posted after training.

V. Training programs

- (1) The training institute shall prepare an annual training program calendar based on training need analysis of its own organization or for meeting the requirement of other utilities/organizations of Power Sector.
- (2) The training calendar shall include Induction course and refresher course as outlined in these CEA guidelines.

VI. Term-End Exam

- (1) After undergoing Induction course training, the trainee shall have to successfully pass the term end exam.
- (2) The term end exam shall be based on the model question banks based on the curriculum contained in these guidelines.
- (3) The training institute shall maintain question banks on the basis of course for training for the personnel engaged in operation and maintenance of generating station in consultation with the Central Electricity Authority and experts from the relevant fields.
- (4) The examination shall be conducted under CCTV surveillance to make it fair and transparent.
- (5) On-job performance may be measured through demonstrated capability to contribute towards taking major equipment in/out of service, handling unit emergencies, maintaining parameters within range, feedback after six months to the training Institute etc. suggesting innovative methods to reduce the occurrence of the fault, adherence to safety norms.
- (6) The term end exam shall carry weightage of 70% of theory and 30% of practical trainings, and the overall passing marks for the term end exam (for both theory and practical) shall be 60%.
- (7) The committee evaluating the performance of the trainees shall comprise of representative/s from training institute and a senior officer from the organization who has deputed the trainee.

- (8) The format for certificate to be issued to trainees on successful completion of the training and for maintaining the records of training of personnel is given at **Annexure-III**.

12. Criteria/Norms for Recognition and Grading of Institute

- (1) Recognition and Grading of institutes shall be made based on the information furnished by Institutes for last financial year as per Questionnaire enclosed at Form A and assessment of the visiting team of CEA for fresh recognition.

- (2) Recognition and Grading of institutions shall be made based on the information furnished by Institutes for last three financial years separately as per Questionnaire enclosed at Form B and assessment of the visiting team of CEA for renewal of recognition.

- (3) For institute seeking for fresh recognition, weightage and norms for each parameter/activity for appraisal shall be as under for the last financial year :

S.No		Maximum Score (a)	Score				remark
			(a*1)	(a*0.7)	(a*0.4)	(a*0)	
1.	Infrastructure						
(1)	No. of Classrooms	5	≥ 3	2	1	0	Minimum one classroom
(2)	Laboratories (Thermal/Hydro/RE)	5					
a.	Thermal (Electrical Lab /Control & Instrumentation Lab/Field Quality Assurance Testing Instruments Lab/ Chemistry Lab/ Water Chemical Treatment Lab/ Power System Simulation Lab/ Transformer Lab/ Self Excitation lab/ Computer Lab/ Mechanical Lab/ Auto Control Laboratory)	5	≥ 6	4-5	2-3	< 2	Weightage as per the number of labs out of the given list

b.	Hydro (Water Chemistry Lab /Transformer Lab /Dam Monitoring Lab/ Governor Maintenance lab/ Fluid Mechanics Lab along with Software and Hardware for computational fluid dynamics (CFD) analysis /Hydro Generation Simulation Lab/ Power System Simulation Lab/ Computer Lab)	5	≥ 5	3-4	1-2	< 1	Weightage as per the number of labs out of the given list
c.	Laboratories and Workshops for Renewable Energy (Solar Generation Lab (with Intensity of Sunlight, Angle of Sunlight)/Load Impact on Generation Voltage/ Harmonics Measurement/Smart Inverter/ any other solar related lab or workshop/Wind Generation related labs & workshops)	10	≥ 5	3-4	1-2	< 1	Weightage as per the number of labs & workshops
(3)	Workshops (Thermal/Hydro)	5					

a.	Thermal Boiler Workshop/ Turbine Workshop/ Electrical Workshop/ Mechanical Workshop/ Fuel Handling System (FHS) Maintenance Workshop/ Transformer Workshop/ Pump Maintenance/ Valve Maintenance/Central workshop	5	≥ 5	3-4	1-2	< 1	Weightage as per the number of workshop out of the given list.
b.	Hydro Mechanical Workshop/ Electrical Workshop/ Transformer Workshop/Turbine Workshop/ Generator Workshop/Valve Workshop	5	≥ 5	3-4	1-2	< 1	Weightage as per the number of labs out of the given list .
(4)	E-Library	1.5	Yes			No	E-Library shall have Journals and relevant Technical Standards etc.
(5)	No. of Multi media Packages	1.5	≥ 20	> 10	> 0	0	
(6)	Simulator (Own/Tie-Up)	5	Yes			No	
(7)	Models	1	≥ 20	> 10	> 0	0	
(8)	Quality of Infrastructure	6					
(i)	Maintenance of training institute	1	Excell ent	Very Good	Good		
(ii)	Air-conditioning	1	Excell ent	Very Good	Good	No	

(iii)	Cleanliness/ Hygiene	1	Excellent	Very Good	Good		
(iv)	No. of Facilities (Transport, Mess, Laundry, Recreation Indoor/Outdoor, Gym)	1	>=3	2	1	0	
(v)	High Speed Internet	1	Yes			No	
(vi)	Medical Facilities (First Aid/On-call doctor/ Nursing Room/ Basic Medicines etc.)	1	Excellent	Very Good	Good		
	Sub Total	30					
2.	Faculty (Core +Empaneled + Guest)						
(1)	Qualification of Faculty	10	(No. of Ph. D.*10+No. of PG*9+No. of Graduates*8)/Total(Core+Empaneled+Guest Faculties)				
(2)	Experience of Faculty	10	(No. of faculty having experience more than 10yrs *10 + No. of faculty having exp. more than 5yrs*5)/Total (Core+Empaneled+Guest faculties)				
(3)	Ratio of (Core+ Empaneled) to (Core+ Empaneled+Guest) (in %)	5	>=60	41-59	20-40	<20	
(4)	Training of Core Faculty (in % of total Core Faculties)	5	>=80	60-79	40-59	<40	Training of no. of Core Faculties
(5)	No. of Papers Published in Conference or Seminars by Core Faculties and No. of Core Faculties Empaneled with other Institutes	2.5	>=3	2	1	0	
(6)	No. of Membership of National or International body of the training institute and No. of working models/simulation	2.5	>=3	2	1	0	

	models made by Core Faculties						
	Sub Total	35					
3.	Course						
(1)	Total Courses Conducted relevant to Power Sector (Days)	15	≥ 100	60-99	10-59	< 10	
(2)	Total Simulator days (in % of total course conducted relevant to Power Sector, in days)	10	$\geq 1\%$	$> 0.7\%$	$> 0.5\%$	$> 0.3\%$	
	Sub Total	25					
4.	Utilization of Budget						
(1)	Budget Utilization	10	≥ 80	60-79	40-59	< 40	
	Grand Total	100					

(4) The institute seeking for renewal of recognition shall be considered for assessment for each parameter and activity for appraisal is as under for last three financial years separately:

S.No		Max. Score	Score				remark
			(a*1)	(a*0.7)	(a*0.4)	(a*0)	
1.	Infrastructure						
(1)	No. of Classrooms	5	≥ 3	2	1	0	Minimum one classroom
(2)	E-Library	1.5	Yes			No	E-Library shall have Journals and relevant Technical Standards etc.
(3)	Laboratories *(Thermal OR Hydro/RE)	5					

a.	Thermal (Electrical Lab /Control & Instrumentation Lab/Field Quality Assurance Testing Instruments lab/ Chemistry Lab/ Water Chemical Treatment Lab/ Power System Simulation Lab/ Transformer Lab/ Self Excitation lab/ Computer Lab/ Mechanical Lab/ Auto Control Laboratory)	5	≥6	4-5	2-3	<2	Weightage as per the number of labs out of the given list.
b.	Hydro (Water Chemistry Lab /Transformer Lab /Dam monitoring lab/ Governor Maintenance lab/ Fluid Mechanics Lab along with Software and Hardware for CFD analysis /Hydro Generation Simulation Lab/ Power System Simulation Lab/ Computer Lab)	5	≥5	3-4	1-2	<1	Weightage as per the number of labs out of the given list
c.	Laboratories and Workshops for Renewable Energy (Solar Generation Lab (with Intensity of Sunlight, Angle of Sunlight)/Load Impact on Generation Voltage/Harmonics Measurement/Smart Inverter/any other solar related lab or workshop/Wind Generation related labs & workshops)	10	≥5	3-4	1-2	<1	Weightage as per the number of labs & workshops
(4)	Workshops	5					

	(Thermal / Hydro)						
a	Thermal Boiler Workshop/ Turbine Workshop/ Electrical Workshop/ Mechanical Workshop/ Fuel Handling System (FHS) Maintenance Workshop/ Transformer Workshop/Pump Maintenance/Valve Maintenance/Central workshop	5	>=5	3-4	1-2	<1	Weightage as per the number of workshop out of the given list.
b.	Hydro (Mechanical Workshop/ Electrical Workshop/ Transformer Workshop/ Turbine Workshop/ Generator Workshop/ Valve Workshop)	5	>=5	3-4	1-2	<1	Weightage as per the number of workshop out of the given list.
(5)	Multi media Packages	1.5	>=20	>10	>0	0	
(6)	Models	1	>=20	>10	>0	0	
(7)	Simulator	5	Yes			No	
(8)	Quality of Infrastructure	6					
(i)	Maintenance of training institute	1	Excell ent	Very Good	Good		
(ii)	Air-conditioning	1					
(iii)	Cleanliness/ Hygiene	1	Excell ent	Very Good	Good		
(iv)	No. of Facilities (Transport, Mess, Laundry, Indoor/Outdoor Sports , Gym)	1	>=3	2	1	0	
(v)	High Speed Internet	1	Yes			No	
(vi)	Medical facilities	1	Excell ent	Very Good	Good		

	(First Aid/On-call doctor/ Nursing Room/ Basic Medicines etc.)						
	Sub Total	30					
2.	Faculty (Core +Empaneled + Guest)						
(1)	Qualification of faculty	7.5	(No. of Ph.D.*7.5+No. of PG*6+No. of Graduates*4.5)/Total(Core+Empaneled+Guest faculties)				
(2)	Experience of faculty	7.5	(No. of Faculty having experience more than 10yrs *7.5 + No. of Faculty exp. more than 5yrs*5)/Total (Core+Empaneled+Guest faculties)				
(3)	Ratio of (Core+ Empaneled) to (Core+ Empaneled+Guest) (in %)	5	≥ 60	41-59	20-40	< 20	
(4)	Training of Core Faculty (in % of total Core Faculties)	5	≥ 80	60-79	40-59	< 40	Training of no. of Core Faculties
(5)	No. of Papers Published in Conference or Seminars by Core Faculties and No. of Core Faculties Empaneled with other Institutes	2.5	≥ 3	2	1	0	
(6)	No. of Membership of National or International body of the training institute and No. of working models or simulation models made by Core Faculties	2.5	≥ 3	2	1	0	
	Sub Total	30					
3.	Courses						
(1)	Total Classroom part of Induction Courses conducted (Days)	10	≥ 100	60-99	10-59	< 10	
(2)	Total Refresher courses conducted (Days)	2.5	≥ 50	30-49	10-29	< 10	

(3)	On-Job Training days (in % of total Induction course conducted in days)	2.5	>=20 %	>10%	>0%	0	
(4)	Total simulator days (in % of total Induction course conducted in days)	5	≥ 1%	>0.7%	>0.5%	>0.3 %	
(5)	Average score obtained in Induction term end exam under CCTV surveillance	10	Average Score entered by institute (on the scale of 1-10)				
	Sub Total	30					
4.	Utilization of Budget						
(1)	Budget Utilization	10	>=80	60-79	40-59	<40	
	Grand Total	100					

(5) The institute seeking for fresh recognition shall furnish the above-mentioned required information for evaluation for last financial year. The institute seeking for renewal of recognition shall furnish the above-mentioned required information for evaluation for last three financial years. In case of non-furnishing of information against any parameter or its part by the institute, zero score will be awarded against that parameter.

(6) The overall grading for the renewal of recognition of training institute shall be given on the basis of computation of the final score based on yearly scores for a three-year period prior to the expiry of the validity of the certificate. The weightages for the three years' shall be 0.5, 0.3 and 0.2 respectively.

(Example: If the validity of the recognition certificate is expiring on 30th June 2023, then three years under consideration will be 2022-23(Y1), 2021-22(Y2) & 2020-21(Y3) having weightage of 0.5, 0.3 & 0.2 respectively)

(7) In case of fresh recognition, if the score obtained on evaluation by the training institute is at least 60, then the training institute shall be recognized for duration of 3 years. The institute shall give an undertaking that curriculum mentioned in these CEA guidelines shall be followed by the training institute **for at least next 3 years**.

(8) The effective date of the Recognition of the New Training Institute shall be from the date of issuing letter to the training institute communicating the recognition.

(9) The training institute seeking for renewal of recognition shall be graded and recognized thereof for the period as under:

Score Obtained	Grading	Rating	Period of Recognition
>79	A	Excellent	5 years
70-79	B	Very Good	4 years
60-69	C	Good	3 years
< 60	—	Not qualified	—

- (10) Based on the recommendations of the team, the observations/recognition of the institute shall be communicated to the head of organization/ training institute.
- (11) CEA Officer(s) may visit the institute any time after granting the recognition to review the action taken on CEA's observations and the progress of improvement in the Standard of the training institute. In case the deficiency with regard to the information submitted to the CEA in Form-A/B and any non-compliance of the observations made by CEA, the recognition of the training institute may be withdrawn by the Authority after issuing the notice to training institute for removal of the deficiency or for the compliance of the observation within 60 days and by giving the opportunity for the training institute to be heard before the CEA.
- (12) In case the training institute has applied for renewal of certificate of recognition within the stipulated time under these guidelines and submitted the requisite fee for recognition after the necessary scrutiny of the application by CEA and the physical assessment of the institute by CEA officer(s) has not been done before expiry of certificate of recognition, then the renewal of training institute shall be done from the next day after expiry of the validity period of the certificate of recognition.
- (13) The recognized training institutes shall update the data annually electronically or through the online portal.
- (14) CEA team may visit the institute any time after granting the recognition to review the action taken on CEA's observations and the progress of improvement in the Standard of the institute.
- (15) The existing Training institute willing to change its category already recognized (i. e, from Category I to Category -II or Category-III or vice versa) shall have to apply again in Form-A, as applicable for Fresh application and the application of the institute shall be processed as Fresh application.

13. Cancellation of Recognition

- (1) The recognition of any training institute shall stand cancelled automatically due to the following reasons: -
- (i) Change in the ownership of the institute by sale or transfer of the institute.
 - (ii) Change / shift in the location of the institute.
- (2) In case of cancellation of recognition due to any reasons as stated above, the institute may apply for its recognition as in the case of a fresh recognition.

14. Regular updation of Syllabus:

- (1) The curriculum given in the guidelines shall be updated by the same sub-committee constituted for finalization of the guidelines in the field of Generation vide office order no. 13/2/2023-HRD/1445-66 dated 31.05.2023. The expert committee constituted vide office order no. 13/2/2022-HRD/933-944 dated 27.7.2022 shall review the recommendations of the sub-committee and finalize the same for approval of the Authority.
- (2) The periodicity for updation of syllabus shall be at least once in three years. However, in case of need, the syllabus may be revised at any time.

CHAPTER III
SYLLABUS FOR GENERATION

13. STRUCTURE FOR CURRICULUM FOR OPERATION & MAINTENANCE OF ELECTRICAL INSTALLATIONS OF GENERATING STATIONS

(1) The mandatory courses, content, methodology and duration for course is outlined below.

(2) Types of Courses

(i) **Induction Course (mandatory)**

a) **Common Courses** for all the trainees shall include the following:

- a. Safety Management
 - Overview of Safety Management
 - Causes and factors of accident
 - Statutory requirement
 - Firefighting equipment and Fire prevention
 - First Aid
- b. Values and Work culture, Conflict Management, Team Building
- c. Relevant regulations and relevant sections of Electricity Act (EA) (including CEA (Measures Relating to Safety & Electric Supply) Regulations, 2023).
- d. Necessary permissions/Clearances for charging of new element
- e. IT Applications and Cyber Security Awareness/overview
- f. Disaster management
- g. Electrical Vehicle-Charging Infrastructure
- h. Battery Storage
- i. Renewable Energy overview (Curriculum for RE General module is provided at section 17 of these guidelines)
- j. Contracts and Materials Management
- k. Project Management: Financing and Execution
- l. Sustainability: Society, Environment & Economy (SSEE) , Mission LIFE- brief presentation and video shows
- m. Resource Management: Reliability & Adequacy
- n. Stores Management
- o. Best Earthing Practices to be implemented for different Electrical Installations

b) **Basic courses** for Engineers, Diploma Holders and ITI personnel engaged in O&M work of Generating Stations (Thermal/ Hydro /Renewables Energy) . (given hereunder at section 14, 15, 16 , 18 & 19) .

- a. Class Room Training- Visuals/Media Usage for imparting training along with Models and Computer Based Training (CBT) packages to understand the Fundamentals.
- b. Visits- sites for understanding layout plans and real time operation, identification and familiarization with equipment, participation in the maintenance works, if any, going on at site, and visit to Manufacturing Units.

c. Practical

i. **Operations-** through Simulators and observer in control room for better understanding

ii.Maintenance-

Practical /working with Engineers. It shall be ensured that the Degree/Diploma holder is rotated so that he/she observes and understands each of these activities such as:

- Preventive maintenance/ Schedule of maintenance
- Trouble Shooting and repair
- Drawings and tracing the equipments,
- Manuals
- Familiarize with tools required for maintenance
- Safety Aspects
- Team work with Diploma holders/ITI

iii.On-job Training

- Drawings and tracing the wires/cables
- Preventive maintenance
- Analysis of fault
- Calibration of Equipment
- Quality of work done
- Team work with Diploma holders/ITI
- Process for permits and clearances
- Mix of degree, diploma and ITI for building team work, improved communication and understanding.
- Awareness regarding Mock drill exercises considering various emergency situations may be added

Total Minimum Duration for Induction Training

(This includes Classroom Training, Practicals and On-Job Training/Practicals)

	Thermal	Hydro	Renewable Energy
Engineer	6 months	3 months	6 months
Supervisors	3 months	2 months	
Technicians	2 months	1 months	3 months

(ii) Refresher Course-

i. Thermal

- a) Boiler Efficiency Analysis and improvement
- b) Co-firing of biomass pellets with coal and its effects on boiler performance, Heat Rate and Auxiliary Power Consumption (APC) of station.
- c) New and emerging technologies viz. Carbon Capture Utilization and Storage, Green Hydrogen in Gas turbines, Green Ammonia.
- d) CEA regulations related to construction, operation standards and safety aspects in thermal power plants along with regulation on Flexible operation of thermal power plants.
- e) Selective catalytic reduction (SCR) / Selective non-catalytic reduction (SNCR) SNCR techniques.
- f) Preventive and conditional monitoring
- g) Two shift operation of Thermal Power Plant
- h) Flexible Thermal generation
- i) Permit to Work(PTW) system and adherence to safety
- j) Augmentation course for operation executives
- k) Course on Simulator
- l) Study and Visit of domestic waste water recovery plants
- m) Environmental issues, challenges and solutions for thermal plants.
- n) Store Management and Inventory Control
- o) Auxiliary power optimization and improvement
- p) Flue Gas Desulphurization (FGD) technique
- q) Coal, Oil and Water sample analysis.
- r) Training on Civil aspects covering Construction and Structure Analysis, Quality Control of Constructions, Track and Bridge Inspection and Maintenance and new technologies.
- s) Training on Mechanical aspects covering Maintenance of Balance of Plant.
- t) Understanding vibration analysis and balancing of equipment
- u) Performance Analysis of Cooling tower, Condenser, Heater, Boiler, Combustion optimization etc.
- v) Turbine cycle Heat Rate analysis and improvement
- w) Understanding turbine Governing system
- x) Inspection of Welding Quality , Welding techniques for P-91 and P-92
- y) Basics of Welding Technology for Technicians
- z) Advanced software for thermal power plant.

ii. Hydro

- a) Operation & Maintenance of Hydro Turbine including Pump Turbine, Generator set and associated auxiliaries such as:
 - a. Penstock Protection Valves/ Main Inlet Valves.
 - b. Bus Duct.
 - c. Electrical Protection and Metering System
 - d. Auxiliary Mechanical Services
 - i. Pumps
 - ii. Electric overhead travelling (EOT) Crane
 - iii. Fire Detection and Protection System
 - iv. Heating Ventilation and Air Condition System (HVAC)
 - v. Cooling Water System (CWS)
 - vi. Compressed Air System
 - vii. Lift
 - viii. Insulating, Lubricating Oil Handling and purification System
 - e. Auxiliary Electrical Services
 - i. Medium Voltage (MV) and Low Voltage (LV) Switchgear
 - ii. Auxiliary Transformers

- iii. Direct current (DC) and Uninterruptible Power Supply (UPS) system
 - iv. Illumination System
 - v. Power and Control Cable and Cable Trays
 - vi. XLPE (cross linked polyethylene) Cables
 - vii. Emergency/ Standby Power Supply System (based on diesel generator (DG) Set/ Battery
 - viii. Energy Storage System (as applicable))
 - ix. APFC (Automatic Power Factor Correction (Capacitor)) Panels
 - f. Drainage, Dewatering and Flood Protection System
 - g. Instrumentation and Telecommunication System
 - h. Security and Surveillance
 - i. PA & Communication System
 - j. DFIM (Doubly Fed Induction Motor) for PSPs.
 - k. Training on Basic dimensioning/ calculation/ location of E&M equipment with Special emphasis on underground power house.
 - l. Training on Metallurgical aspects/ protection coating and their application and silt erosion etc.
 - m. Training on Engineering, Procurement and Completion.
 - n. Flood protection and safety measures.
 - o. Various types of Gates (Intake, Surge Shaft and TRT Gate etc.) including trash rack system.
 - p. Discharge Measuring System.
 - q. Gas Insulated/Air Insulated Switchgear.
 - r. Power Transformer and Station/Unit Auxiliary
- b) Generator Excitation System
 - c) Governing System of Hydraulic Turbines (RGMO & FGMO) including Power Feedback and Frequency Control Mode of Operation)
 - d) Gas Insulated Switchgear (GIS)
 - e) Earthing System in Hydro power station
 - f) O&M Aspect of HM Equipment in Hydro Electric (HE) Projects
 - g) Power System Protection & Automation
 - h) Contracts and Purchase Management
 - i) Store Management & Inventory Control
 - j) Training on Civil aspects covering Maintenance of Dam/Barrage, Head race tunnels/channels, Surge shaft/surge chambers, Pressure shaft/Penstock, Underground and surface power house, Tailrace channel or tailrace tunnel etc.
 - k) Training on Geological aspects covering drilling, rock analysis etc.
 - l) Training on Environmental aspects covering concentration of nutrients, water temperature, and the river's flow , reports on compliance to Ministry of Environment, Forest and Climate Change (MoEF&CC) clearance letters, CTO (Consent to Operate) etc.
 - m) Regulatory/ Legal Aspects of Hydro Electric Power Plant, viz. Indus water treaty.
 - n) Preventive and Conditional Monitoring.
- iii. Refresher course topics for RE: These may be as per the organization specific requirements and the latest technological development in RE.
- (3) As per clause 7 (3) of CEA Safety Regulation, 2023 the technicians assisting Engineers or Supervisors who do not have requisite qualification as mentioned in this regulation, shall have to undergo the training either from Power Sector Skill Council or from training institute recognized by the Authority. The same is reproduced as under:

“The Technicians to assist Engineers or Supervisors shall possess a certificate in appropriate trade, preferably with a two years course from an Industrial Training Institute

recognised by the Central Government or State Government and shall have successfully undergone the type of training as specified in guidelines as per sub regulation (4), within two years from the date of engagement or appointment:

Provided that the existing employees, as on the date of notification of these regulations, who are extending technical assistance to Engineers or Supervisors and do not have requisite qualification as mentioned in this regulation, shall have to undergo the training either from Power Sector Skill Council or from training institute recognised by the Authority for carrying out trade specific course as per the guidelines issued by the Authority and get certificate as mentioned above within two years from the date of notification of these regulations.”

The details of these courses are available on the site of power skill council. These courses are revised from time to time with the approval of National Council for Vocational Education Training (NCVET). The latest information regarding these courses can be seen at PSSC websites (psscindia.org)."

14. Curriculum for Thermal -Coal/lignite Based Power Plant

(1) CURRICULUM FOR ENGINEERS ENGAGED IN THE OPERATION AND MAINTENANCE OF THE COAL/Lignite BASED POWER PLANT (“Basic Course” element of Mandatory Induction Course)

It is suggested that degree holder’s course content may include design for analysis and automation., a brief on Ultra Critical, Super Critical, Sub Critical boilers, Mandatory clearances from Boiler Inspector, Electrical Inspector & meeting environmental norms (Sox, NOx, particulate matters, water consumption). The mandatory course curriculum given below is limited **to our scope in the Regulation**

a) CLASSROOM

- a. Power Plant- layout of power plants, Thermodynamics: Temp entropy Diagram, Law of Thermodynamics, Carnot cycle, Rankine cycle and its modifications.
- b. Application of thermodynamic cycles for power generation plant, Super Critical Technology: About the technology, Advantages, Difference from sub critical plant, Coal characteristics
- c. Boiler
 - i. Fundamentals, combustion theory,
 - ii. Water Circulation System,
 - iii. Steam Circulation System,
 - iv. Air circulation system-Primary air, Secondary air, Induced draught (ID) Fans, forced draft (FD) Fans
 - v. Fuel Firing System
 - vi. Coal characteristics, methods of obtaining gross calorific value (GCV) of coal (as received, as billed, as fired) and third party analysis of coal samples.
- d. Turbine-
 - i. Feed Water System- Boiler feed pumps construction, arrangement, High pressure heaters, Feed regulating station, Drip/drain system
 - ii. Condensate System-, Condensate pumps, Low pressure heaters, Deaerators
 - iii. Vacuum System- Condenser, Vacuum pump & Ejectors Gland steam coolers, Auxiliary Steam Supply System
 - iv. Turbine Lube Oil System and Turbine Sealing System
 - v. Turbine cycle system-checks,

e. Generator

- i. Stator, Rotor, auxiliary system, Excitation System Generator Transformer.
- ii. Automatic Voltage Regulation (AVR)
- iii. Power Supply System Overview, Switchyard and It's Interfaces

f. **Switchyard Equipment's:** Bus Bars & Schemes. Unit Transformers, Lightning Arrestor, Isolators, Earth Switches, Instrument Transformers (current transformers, potential transformers) and Power Line Carrier Communication (PLCC)

g. Electrical Switchgears

- i. Basics of switchgear
- ii. Circuit Breakers- Low Voltage, Medium Voltage & Extra High Voltage
- iii. All major supply boards, Alternating Current (AC) Supply System in Power Plant, Direct Current (DC) system and batteries, Batteries, Battery Charging System, Uninterrupted Power Supply (UPS). Station Emergency lighting arrangements.

h. Fundamentals of auxiliary Systems

- i. Electrostatic Precipitators, Chimney, Circulation Water System, Cooling Tower, Pretreatment Plant, Demineralization Plant (DM) Plant, Coal Handling Plant, Ash Handling System.
- ii. Fire Protection Systems, Pumps, Emulsifiers and other protection systems
- iii. Motors, Variable frequency drive, fans and pumps
- iv. Effluent treatment Plant, Condensate Polishing units. EOT cranes, agitators, Ventilators and AC systems, Mill reject systems.

i. Interlocks, Protections and pre-commissioning activities

- i. Boiler and its Auxiliaries
- ii. Turbine and its Auxiliaries
- iii. Generators, excitation system, generator seals, Generator protection- earth fault in rotor and stator, negative phase sequence, loss of excitation, differential protection, back up protection, reverse power protection, under-voltage protection, overload protection, relays used, method of setting and their testing, and overheating of rotors.
- iv. Transformer commissioning, dielectric strength of oil, insulation resistance, tap changers, filtration of oil, pre-commissioning testing. Tan-Delta resistivity of oil and preventive maintenance of transformers, dissolved gas analysis
- v. Transformer Protection -Buchholz relay, over current, differential and earth fault protection,
- vi. Relays used, testing and settings
- vii. Line protection, fault analysis, bus-bar and local breaker back-up protection (LBB). Bus differential protection
- viii. Circuit breakers, commissioning and maintenance, isolators, dis-connectors, bus, bar arrangements, charging, synchronizing with the grid, disconnecting for repairs, maintenance of switchgear contactors
- ix. Thermography monitoring
- x. Control cables, layouts of equipment's at voltage exceeding 650V, testing & maintenance
- xi. Interlocking, sequential control circuits, details of components used.
- xii. Motor Protection: Overload Protection, Stalling and Short Circuit Protection. Under Voltage and Single Phasing Protection
- xiii. Unit protection schemes for lines. Distance Protection, Power Swing blocking, Voltage Transformer (VT) failure supervision and Switch-on-to-fault (SOTF) Protection
- xiv. Bus-Bar Protection: Carrier Aided Schemes and Auto Reclosing, LBB Protection

j. Instrumentation

- i. Principle of electronic controls and transistorized circuits.
- ii. Pneumatic and di-electric transmitters and receivers, servomotors
- iii. Interlocking, sequential control circuits, details of components used.
- iv. Indicating instruments, measuring instruments, recorders and analyzers.
- v. Pneumatic systems, electrical systems, electronic systems and maintenance aspects, inspection and testing aspects.
- vi. Component familiarization and various types of circuits and microprocessors
- vii. Piping schematic with details of various valves and transmitters, Equipment details - mechanical and electrical, Control philosophy, Pre-commissioning checks and commissioning procedures
- viii. Instrumentation and control scheme of fuel, air, flue gas, feed water and steam systems including their measurements
- ix. Furnace Safeguard Supervisory System (FSSS), plant equipment protection and interlock system.
- x. HP-LP Bypass. Automatic Turbine Run-up Systems (ATRS), analog and digital controllers, rolling of turbine procedure. Turbine stress Evaluator (TSE). Automatic Turbine Testing (ATT), Turbine Governing system-Electrical system lineup, Protections and interlocks.
- xi. Data acquisition system / digital distributed control (DDC), UPS, control room layout
- xii. Distributed Digital Control, Monitoring Information System (DDCMIS)
- xiii. Cybersecurity.
- xiv. Coordinated Master Control (CMC)-Air master, Fuel master, BLI, Turbine follow mode, Boiler follow mode
- xv. Starting and control equipment's of various types of motors, station battery-care and maintenance, trickle charging and extended charging, operation and maintenance of rectifiers and battery chargers, UPS, emergency-power supply.

k. Commissioning of Unit

Start up, Synchronization, Shut down procedures and checks. Commissioning, ramp up and ramp down, Flexible generation of a power plant, Start up and shut down Procedure,

l. Renovation and Modernization (R&M) of Thermal Plants

- i. Residual Life Assessment (RLA) studies
- ii. Condition Assessment (CA) studies
- iii. Destructive Test Studies
- iv. Best practices for upgrading and modernizing thermal power projects to enhance efficiency, reliability, and safety
- v. Case studies of successfully renovated thermal power projects
- vi. Commercial Aspects of R&M of thermal power projects i.e. Cost-benefit analysis, tariff determination etc.

m. Power Plant Hazards

- i. Industrial Hazards
- ii. Power plant hazards
- iii. Risks, Hazards & Accidents
- iv. Hazard Identification and Risk Assessment
- v. Legal aspects of Safety
- vi. Personal protective equipment & clothing
- vii. Safety & House keeping

n. Major Safety Risks

- i. Fall Protection
- ii. Road Safety

- iii. Fire Safety
- iv. Material Handling

o. Safety in O&M

- i. Introduction to E&M Safety Rules -1996
- ii. Familiarization of Safety rules
- iii. Basic Safety Rules SR 1 to 11.
- iv. Different Safety documents -LWC, PTW, PTW (Romp) & SFT -Related Precautions to be taken
 - SR1. Applications of the Electrical and Mechanical Safety Rules.
 - SR2. Safety precautions for work on or adjacent to plant and high voltage apparatus.
 - SR3. Safety precautions for testing plant and high Voltage apparatus.
 - SR4. Approach to exposed high voltage conductors or insulators.
 - SR5. Safety precautions for work on or testing of medium voltage or low voltage apparatus.
 - SR6. Operation to achieve safety from the system.
 - SR7. Demarcation of work areas.
 - SR8. Identification of plant and apparatus.
 - SR9. Safety precautions for work/testing on plant.
 - SR10. Venting of plant and apparatus
 - SR11. Purging of plant and apparatus.

p. Procedure - Safety Document (LWC/PTW/PTW(ROMP) /SFT)

- i. Preparation
- ii. Issue
- iii. Receipt
- iv. Transfer
- v. Suspension and
- vi. Cancellation
- vii. lockout/tagout (LOTO) System

q. Operation of a power plant

- i. Economic load despatch, power system control and operation, MVAR-control, voltage Regulation and frequency control, capacitors and reactors, islanding schemes, carrier current equipments, telephones, telemetering
- ii. Energy Conservation in power plants: Energy Conservation Act. Potential areas for energy saving in power plants, Waste heat areas and utilization.
- iii. Energy Audit, Conservation of Water in power plant and water audit. Demand side management
- iv. Renewable Energy- Wind Power, Solar Power Plant, Biomass, pellet firing
- v. Storages
- vi. Electrical vehicles-load flow

b) Operation Training

- i. Simulator Training
- ii. Control room
- iii. Store & Inventory Management
- iv. Working with Engineer at Power Plant

(i) Electrical Field in general

- i. Checking stator water cooling system
- ii. Checking Hydrogen cooling system, charging of Hydrogen

- iii. Checking of seal oil system
- iv. Checking up excitation system
- v. Checking & Resetting of Relays
- vi. Electrical Isolation of supply
- vii. Checking the position of breakers/isolators/CTs/PTs
- viii. Routine checks on transformers
- ix. Drawing power from grid & giving power for charging feeders
- x. Liaison with load despatch center/calculation of daily statistics
- xi. Frequency & voltage control/checking synchronous scope

(ii) Boiler Field Engineer

- i. Routine checks at Mills
- ii. Checking of Mill reject system
- iii. Checking of scrapper conveyor and clinker grinder
- iv. Checking of oil guns/ignitors & their cleaning
- v. Checking of drum level gauge glass/charging of gauge glass
- vi. Checking of ID/FD/PA/Ignitor/Scanner fans & their oil system
- vii. Checking of ESP's and EP control room

(iii) Turbine Field Engineer

- i. Checking Mean Operating Temperature (MOT) level
- ii. Checking position of IV'S, CV'S & EV'S and barring gear
- iii. Checking of boiler feed pump (BFP) & its lube oil system, condensate/drip/CW pumps operation
- iv. Local Scope tube operation of BFP
- v. Charging of HP & IP bypass system
- vi. Working with Furnace Safeguard Supervisory System (FSSS)/BMS Control

(iv) Turbine & Generator control Engineer

- i. Control of Deaerator level/ Condenser level, Control pressure and temperature of 16ata header & HP/LP bypass System
- ii. Operation of BFP
- iii. Synchronizing matching voltage & frequency
- iv. Take AVR into circuit
- v. Supply change over from station to unit & unit to station
- vi. Ash Handling System, Water Treatment Plant, Fuel Oil Handling System, Coal handling plant.

c) Maintenance Training-

- i. Preventive maintenance, troubleshooting & repairing with total quality assurance & Inspection
- ii. Rotary Equipment Maintenance-mills/fans and air preheaters,
- iii. Maintenance activities at the burner & firing system
- iv. Pumps & Drive Maintenance- various pumps, bearings, couplings, glands and piping joints etc.
- v. Various drives related to pumps, alignment and balancing.
- vi. Turbine & Auxiliaries Maintenance- activities related to turbine governors, barring gears, condenser, condensate pumps & ejectors, LP heaters, gland steam cooler & deaerator. BFP's & HP heaters and lube oil system including centrifuge
- vii. AC/DC Supply System, Station Batteries & DG Set & Cabling

d) On-Job Training

- i. HT/LT motors
- ii. Valve/ Pump Maintenance
- iii. Transformer maintenance -LT/HT/EHV Transformer

- iv. AC/DC supply systems, station batteries and DG sets
- v. Generator/ excitation systems, bus duct
- vi. Switchyard / switchgear equipment maintenance- isolators/breakers, CTs/TPs 6.6 kV breaker, 0.415 breaker, relay testing, Power Line Carrier Communication (PLCC)
- vii. Control System
- viii. Data Acquisition System & DDC
- ix. Analytic Instruments
- x. Instrument Air System & Actuators

e) Suggestion:

Appropriate training on Mechanical Side of Thermal Power Plant may be included as per the organization needs.

(2) CURRICULUM FOR SUPERVISORS ASSISTING ENGINEERS ENGAGED IN OPERATION AND MAINTENANCE OF COAL/Lignite BASED POWER PLANT

a) CLASSROOM

Power Plant- layout of a power plants, Thermodynamics: Temp entropy Diagram, Law of Thermodynamics, Carnot cycle, Rankine cycle and its modifications .Application of thermodynamic cycles for power generation plant, Super Critical Technology: About the technology, Advantages, Difference from sub critical plant, Coal characteristics

a. Main Plant

- i. **Boiler**-Fundamentals, combustion theory,
- ii. Water Circulation System,
- iii. Steam Circulation System,
- iv. Air circulation system-Primary air, Secondary air, ID Fans, FD Fans
- v. Fuel Firing System,
- vi. Protections and interlocks

b. Turbine-

- i. Feed Water System- Boiler feed pumps construction, arrangement, High pressure heaters, Feed regulating station, Drip/drain system
- ii. Condensate System-, Condensate pumps, Low pressure heaters, Deaerators
- iii. Vacuum System- Condenser, Vacuum pump & Ejectors Gland steam coolers, Auxiliary Steam Supply System
- iv. Turbine Lube Oil System and Turbine Sealing System
- v. Turbine cycle system-checks,

c. Generator

- i. Stator, Rotor, auxiliary system, Excitation System
- ii. Automatic Voltage Regulation (AVR)
- iii. Power Supply System Overview, Switchyard and It's Interfaces
- iv. Switchyard Equipment's: Bus Bars & Schemes. Transformers, Lightening Arrestor, Isolators, Earth Switches, Instrument Transformers (current transformers, potential transformer) & PLCC
- v. Electrical Switchgears: Basics of switchgear,
- vi. Circuit Breakers- Low Voltage, Medium Voltage & Extra High Voltage
- vii. All major supply boards, AC Supply System in Power Plant, DC system and batteries, Batteries, Battery Charging System, UPS. Station Emergency lighting arrangements

d. Fundamentals of auxiliary Systems

- i. Electrostatic Precipitators, Chimney, Circulation Water System, Cooling Tower, Pretreatment Plant, DM Plant, Coal Handling Plant, Ash Handling System,
- ii. Motors, Variable frequency drive, fans, pumps
- iii. Lubricants: Classification of various types of Lubricants and greases used in the plant. Principle of hydrodynamic and hydrostatic lubrication. Properties of lubricants and Control fluids, Lubricants: Handling and disposal. Lubrication Schemes and their components of Fans, Pumps, gearboxes, Air-heater etc.

e. Interlocks and Protections

- i. Boiler and its Auxiliaries and pre-commissioning activities
- ii. Turbine and its Auxiliaries and pre-commissioning activities
- iii. Maintenance and commissioning of generators, excitation system, generator seals,
- iv. Generator protection- earth fault in rotor and stator, negative phase sequence, loss of excitation, differential protection, back up protection, reverse power protection, under-voltage protection, overload protection, relays used, method of setting and their testing, and overheating of rotors.
- v. Transformer commissioning, dielectric strength of oil, insulation resistance, tap changers, filtration of oil, pre-commissioning testing. Tan-Delta resistivity of oil and preventive maintenance of transformers, dissolved gas analysis
- vi. Transformer Protection -Buchholz relay, over current, differential and earth fault protection,
- vii. Relays used, testing and settings
- viii. Line protection, fault analysis, bus-bar and local breaker back-up protection (LBB). Bus differential protection
- ix. Circuit breakers, commissioning and maintenance, isolators, dis-connectors, bus, bar arrangements, charging, synchronizing with the grid, disconnecting for repairs, maintenance of switchgear contactors
- x. Thermography monitoring
- xi. Control cables, layouts of equipment's at voltage exceeding 650V, testing and maintenance
- xii. Interlocking, sequential control circuits, details of components used.
- xiii. Motor Protection: Overload Protection, Stalling and Short Circuit Protection. Under Voltage and Single Phasing Protection
- xiv. Unit protection schemes for lines. Distance Protection, Power Swing blocking, VT failure supervision and SOTF Protection
- xv. Bus-Bar Protection: Carrier Aided Schemes and Auto Reclosing, LBB Protection

f. Commissioning of Unit

Start up, Synchronization, Shut down procedures and checks.

g. Renovation and Modernization (R&M) of Thermal Plants

- i. Residual Life Assessment (RLA) studies
- ii. Condition Assessment (CA) studies
- iii. Destructive Test Studies
- iv. Best practices for upgrading and modernizing thermal power projects to enhance efficiency, reliability, and safety
- v. Case studies of successfully renovated thermal power projects
- vi. Commercial Aspects of R&M of thermal power projects i.e. Cost-benefit analysis, tariff determination etc.

h. Power Plant Hazards

- i. Industrial Hazards
- ii. Power plant hazards
- iii. Risks, Hazards & Accidents

- iv. Hazard Identification and Risk Assessment
- v. Legal aspects of Safety
- vi. Personal protective equipment & clothing
- vii. Safety & House keeping

i. Major Safety Risks

- i. Fall Protection
- ii. Road Safety
- iii. Fire Safety
- iv. Material Handling

j. Safety in O&M

- i. Introduction to E&M Safety Rules -1996
- ii. Familiarization of Safety rules
- iii. Basic Safety Rules SR 1 to 11.
- iv. Different Safety documents -LWC, PTW, PTW (Romp) & SFT -Related Precautions to be taken
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 - SR2. Safety precautions for work on or adjacent to plant and high voltage apparatus.
 - SR3. Safety precautions for testing plant and high Voltage apparatus.
 - SR4. Approach to exposed high voltage conductors or insulators.
 - SR5. Safety precautions for work on or testing of medium voltage or low voltage apparatus.
 - SR6. Operation to achieve safety from the system.
 - SR7. Demarcation of work areas.
 - SR8. Identification of plant and apparatus.
 - SR9. Safety precautions for work/testing on plant.
 - SR10. Venting of plant and apparatus
 - SR11. Purging of plant and apparatus.

k. Procedure - Safety Document (LWC/PTW/PTW(ROMP) /SFT)

- i. Preparation
- ii. Issue
- iii. Receipt
- iv. Transfer
- v. Suspension and
- vi. Cancellation
- vii. LOTO System

b) Operations/Practicals

a. Boiler

- i. Routine checks at Mills
- ii. Checking of Mill reject system
- iii. Checking of scrapper conveyor and clinker grinder
- iv. Checking of oil guns/ignitors & their cleaning
- v. Checking of drum level gauge glass/charging of gauge glass
- vi. Checking of ID/FD/PA/Ignitor/Scanner fans & their oil system
- vii. Checking of ESP's and EP control room

b. Turbine

- i. Checking MOT level
- ii. Checking position of IV'S, CV'S & EV'S and barring gear

- iii. Checking of BFP, its lube oil system, condensate/drip/CW pumps operation
- iv. Local Scope tube operation of BFP
- v. Charging of HP & IP bypass system

c. Electrical Field in general

- i. Checking stator water cooling system
- ii. Checking Hydrogen cooling system, charging of Hydrogen
- iii. Checking of seal oil system
- iv. Checking up excitation system
- v. Checking & Resetting of Relays
- vi. Electrical Isolation of supply
- vii. Checking the position of breakers/isolators/CTs/PTs
- viii. Routine checks on transformers
- ix. Drawing power from grid & giving power for charging feeders
- x. Liaison with load despatch center/calculation of daily statistics
- xi. Frequency & voltage control/checking synchronous scope
- xii. Plant Visit

c) Maintenance/On job

- a. HT/LT motors maintenance
- b. Transformer maintenance
- c. AC/DC supply systems, station batteries and DG sets
- d. Generator/ excitation systems
- e. Switchyard / switchgear equipment maintenance
- f. Electrical Testing Lab Activities and equipment of electrical testing lab.
- g. C&I Lab: Equipment and Tools in C&I lab. Functions and operations carried out in C&I Lab, Calibration and repairs for UCB and field instruments, Pneumatic components
- h. calibration and testing case studies, repair of UCB/Field instruments
- i. Control system - basic principles, constructional features, calibration, preventive maintenance and troubleshooting of analog control systems, level, flow, pressure and temperature control systems, component / cards used in control systems, static and dynamic timing, control valves and dampers
- j. Data acquisition system. or distributed digital control system - basic principles, constructional features, calibration, preventive maintenance and troubleshooting of digital and analog inputs to Digital Automation System (DAS) and their conditioning, I/O and interface, functioning of alarms, monitoring formats and logs, sequence of events

d) Suggestion:

Appropriate training on Mechanical Side of Thermal Power Plant may be included as per the organization needs.

(3) CURRICULUM FOR TECHNICIANS ASSISTING SUPERVISORS ENGAGED IN THE OPERATION AND MAINTENANCE OF THE COAL/Lignite BASED THERMAL POWER PLANTS

a) Classroom

- a. Power plant familiarization
- b. Fundamental units and their conversion (mechanical, electrical, thermo-dynamic).
- c. Engineering drawing and practice.
- d. Principle and working of alternating current and direct current generators

- e. Principle and working of transformers and their parallel operation,
 - f. Principle and working of alternating current & direct current motors, their speed characteristics, controls
 - g. Storage battery- principle, construction and charging
 - h. Fuels and combustion, types of fuels – their properties and testing, requirement of efficient combustion
 - i. Boiler and boiler house plant and auxiliaries:
 - j. Turbine and turbine house auxiliaries.
 - k. Condenser and vacuum extraction plant
 - l. Cooling water systems and cooling towers
 - m. Water conditioning, pre-treatment and demineralization, water chemistry.
 - n. Coal handling
 - o. Ash handling and electrostatic precipitation
- p. Flow diagrams of basic cycles and scheme tracing:
- i. Coal handling.
 - ii. Steam and condensate
 - iii. Ash and slag handling
 - iv. Station services - domestic water, air conditioning, ventilation, lifts
 - v. Air services, air compressors, switchgear
 - vi. Bearing cooling, and general service water system
 - vii. Circulating water system
 - viii. Feed water and reheating plant
 - ix. Fuel oil system
 - x. Station batteries and battery charging equipment
 - xi. Station lighting, power supply and distribution boards.

q. **Power Plant Hazards**

- i. Industrial Hazards
- ii. Power plant hazards
- iii. Risks, Hazards & Accidents
- iv. Hazard Identification and Risk Assessment
- v. Legal aspects of Safety
- vi. Personal protective equipment & clothing
- vii. Safety & House keeping

r. **Major Safety Risks**

- i. Fall Protection
- ii. Road Safety
- iii. Fire Safety
- iv. Material Handling

s. **Safety in O&M**

- i. Introduction to E&M Safety Rules -1996
- ii. Familiarization of Safety rules
- iii. Basic Safety Rules SR 1 to 11.
- iv. Different Safety documents -LWC, PTW, PTW (Romp) & SFT -Related Precautions to be taken
 - SRI. Applications of the Electrical and Mechanical Safety Rules.
 - SR2. Safety precautions for work on or adjacent to plant and high voltage apparatus.
 - SR3. Safety precautions for testing plant and high Voltage apparatus.
 - SR4. Approach to exposed high voltage conductors or insulators.
 - SR5. Safely precautions for work on or testing of medium voltage or low voltage apparatus.
 - SR6. Operation to achieve safety from the system.

- SR7. Demarcation of work areas.
- SR8. Identification of plant and apparatus.
- SR9. Safety precautions for work/testing on plant.
- SR10. Venting of plant and apparatus
- SR11. Purging of plant and apparatus.

t. Procedure - Safety Document (LWC/PTW/PTW(ROMP) /SFT)

- i. Preparation
- ii. Issue
- iii. Receipt
- iv. Transfer
- v. Suspension and
- vi. Cancellation
- vii. LOTO System

b) Practicals/ On-Job

- a. Use of machines, tools and tackles, gauges, fits and clearances, tolerances, brazing,
- b. Soldering and welding, bearings, gears and thread, fasteners
- c. Bearings types, installation and removal procedures and maintenance of clearances and tolerances, oil seals types, their applications and clearances.
- d. Lubrication and cooling principles.
- e. Electrical labs
- f. Controls and Instrumentation Lab.

c) Suggestion:

Appropriate training on Mechanical Side of Thermal Power Plant may be included as per the organization needs.

15. Curriculum for Combined Cycle Gas Turbine based Power Plants

(1) CURRICULUM FOR ENGINEERS AND SUPERVISORS ENGAGED IN THE OPERATION AND MAINTENANCE OF THE COMBINED CYCLE GAS TURBINE BASED POWER PLANTS

- a) Power sector scenario of India
- b) Introduction to Gas turbines & Combined cycle power generation**
 - a. The Gas Turbine (Brayton) Cycle
 - b. The Steam-Water (Rankine) Cycle
 - c. Heat Recovery Steam Generator (HRSG)
 - d. The Combined Cycle
 - e. Benefits of the Combined Cycle
 - f. Plant Layout & Auxiliary systems
- c) Constructional features of Gas turbine system**
 - a. Inlet filter system
 - b. Compressor
 - c. Combustion Chamber
 - d. Turbine
 - e. Gas Turbine (GT) Dampers

- d) **Features of Gas turbine Support systems**
 - a. Fuel system (Liquid & Gas)
 - b. Lubricating Oil System of turbine & Generator
 - c. Cooling Water/Air Systems
 - d. Water Wash System
 - e. Water/Steam Injection System
 - f. Ventilation and Heating System
 - g. Introduction to Electrical Systems and Auxiliary supply system in power plants
 - h. Generator and Generator Auxiliary System

- e) **Gas Turbine start-up, rolling & loading**
 - a. Start Permissive
 - b. Checks during start up
 - c. Barring gear operation
 - d. Synchronization
 - e. Full Load /Partial Load operation
 - f. GT Routine Checks

- f) **Gas turbine control system**
 - a. Governing of gas turbine
 - b. Load control
 - c. Temperature control

- g) **Gas Turbine shut down**
 - a. Checks during Emergency trip
 - b. Checks during planned shut down
 - c. Shut down procedure

- h) **Performance assessment of gas turbines**
 - a. Impact of operation parameters,
 - b. Impact of Environmental Conditions
 - c. Ambient Temperature
 - d. Altitude
 - e. Humidity
 - f. Choice of Fuel
 - g. Air Filter performance
 - h. Blade fouling
 - i. Causes
 - j. Online/Offline washing

- i) **Features of HRSG & various circuits**
 - a. Types of HRSG
 - b. Condensate & feed heater system
 - c. Economizer
 - d. Evaporator
 - e. Super heater
 - f. HP, IP & LP system
 - g. Boiler drums
 - h. Circulation theory

- j) **Start up of HRSG**
 - a. Start Permissive
 - b. Checks during start up
 - c. HRSG Gas In

k) Auxiliaries of Combined cycle power plant

- a. Raw water system
- b. Condenser Cooling water system
- c. DM water system
- d. Instrument and service air system
- e. Cooling tower system
- f. Generator Excitation system and Capability curve

l) Performance assessment of CCPP

- a. Impact of operation parameters,
- b. Impact of Environmental Conditions
- c. Switchyard Equipment, Systems and Bus switching schemes
- d. Steam Turbine start-up: Cold/Hot start ups and Unit Synchronization.
- e. Preservation and recommissioning of CCPP.

m) Safety module Introduction

- a. Power plant process complexity & need for Competent & qualified person
- b. What is safety Competence?
- c. Safety Policy –Elements
- d. Six Principles of Safety.
- e. Responsibility Matrix

n) Power Plant Hazards

- a. Industrial Hazards
- b. Power plant hazards
- c. Risks, Hazards & Accidents
- d. Hazard Identification and Risk Assessment
- e. Legal aspects of Safety
- f. Personal protective equipment & clothing
- g. Safety & House keeping

o) Major Safety Risks

- a. Fall Protection
- b. Road Safety
- c. Fire Safety
- d. Material Handling

p) Safety in O&M

- a. Introduction to E&M Safety Rules -1996
- b. Familiarization of Safety rules
- c. Basic Safety Rules SR 1 to 11.
- d. Different Safety documents -LWC, PTW, PTW (Romp) & SFT -Related Precautions to be taken

SRI. Applications of the Electrical and Mechanical Safety Rules.

SR2. Safety precautions for work on or adjacent to plant and high voltage apparatus.

SR3. Safety precautions for testing plant and high Voltage apparatus.

SR4. Approach to exposed high voltage conductors or insulators.

SR5. Safety precautions for work on or testing of medium voltage or low voltage apparatus.

- SR6. Operation to achieve safety from the system.
- SR7. Demarcation of work areas.
- SR8. Identification of plant and apparatus.
- SR9. Safety precautions for work/testing on plant.
- SR10. Venting of plant and apparatus
- SR11. Purging of plant and apparatus.

q) Procedure - Safety Document (LWC/PTW/PTW(ROMP) /SFT)

- a. Preparation
- b. Issue
- c. Receipt
- d. Transfer
- e. Suspension and
- f. Cancellation
- g. LOTO System

r) Roles & Responsibilities of CP, AP, SAP

- a. Precautions for Isolation and Normalization function
- b. Isolation procedure as per E&M safety rule
- c. Importance of Safety Related Compliance Claim (SRCC)
- d. Safety in welding and gas cutting
- e. Safety in erection, use and dismantling of scaffolds
- f. Concept of Preventive, Predictive, Maintenance.
- g. Long-Term Short-Term Planning.
- h. Maintenance Planning of any equipments. Spare parts planning. Analyzing Past history of equipments.
- i. Understanding maintenance modules of SAP
- j. PR Raising – issues and concerns. Understanding relevant clauses of DOP, Material PO, and Service PO preparation
- k. How to prepare technical specification of an item for purchase and Understanding Material Coding. Inspection, issue & return of material.

(2) CURRICULUM FOR TECHNICIANS ENGAGED IN THE OPERATION AND MAINTENANCE OF THE COMBINED CYCLE GAS TURBINE BASED POWER PLANTS

a) Classroom

- a. Gas Power plant familiarization
- b. Fundamental units and their conversion (Mechanical, electrical, thermo-dynamic).
- c. Engineering drawing and practice.
- d. Fuels and combustion types of fuels – their properties and testing, requirement of efficient combustion Gas turbine and WHRB
 - i. General description.
 - ii. Arrangement of Gas turbines
 - iii. WHRB (Waste Heat Recovery Boiler)
 - iv. Instrumentation and Control system.
 - v. Fabrication and assembly of different parts of gas turbine and its accessories.
 - vi. High pressure welding.
 - vii. Fuel storage and transport arrangement.

- viii. Operation appreciation (start-up, running and shutdown).
- e. Water conditioning, pre-treatment and demineralization.
- f. Steam turbine and turbine house auxiliaries.
 - i. Fundamental principle of steam turbine
 - ii. Theory and operation of steam turbine
 - iii. Arrangement of steam turbine.
 - iv. Governing and protection of turbine.
 - v. Operation appreciation (start-up, running and shutdown)
- g. Handling of gas turbine, steam turbine and WHRB
- h. Condenser and vacuum extraction plant :
 - i. Purpose and function.
 - ii. Construction of surface condenser and vacuum pumps
- i. Cooling water systems and cooling towers.
- j. Flow diagrams of basic cycles and scheme tracing :
 - i. Steam and condensate
 - ii. Station services, domestic water, air conditioning, ventilation, lifts
 - iii. Air services, air compressors, switchgear.
 - iv. Bearing cooling and general service water system.
 - v. Circulating water system.
 - vi. Feed water system
 - vii. Fuel oil system
 - viii. Station batteries and battery charging equipment
 - ix. Station lighting, power supply and distribution boards
- k. Mechanical appreciation – correct use of machines, tools and tackles, gauges, fits and clearances, tolerances, brazing, soldering and welding, bearings, gears and thread, fasteners
Station instrumentation and controls.
- l. Fire-fighting installations in thermal power station.
- m. Electric shocks, first aid, acid burn, alkali wounds, chlorine gas poisoning and their treatment.
Duties and responsibilities of operators and plant attendants, carrying out instructions, reporting to supervisors, recording reading unusual occurrences, expected behavior, discipline, sincerity, cleanliness and love for machines.
- n. Safety of personnel and equipment, cleanliness, caution and care in power station working.
- o. How electricity is generated, transmitted and distributed i.e. generator to Consumer service board.
- p. Fundamental units, conversion and measurement of electrical quantities.
- q. Principle and working of alternating current and direct current generators and their parallel operation.
- r. Principle and working of transformers and their parallel operation.
- s. Principle and working of alternating current and direct current motors, their speed characteristics, controls.
- t. Storage battery- principle, construction and charging.
- u. Alternator cooling, different systems of cooling, advantages of hydrogen cooling over others, hydrogen plant.

16. Curriculum for Hydro Power Plant

(1) CURRICULUM FOR ENGINEERS ENGAGED IN THE OPERATION AND MAINTENANCE OF THE HYDRO POWER PLANT

- a) Development of Hydro Power Project (Civil)
 - a. Introduction to major components of Hydro-electric Power project
 - b. Hydro Power Basic terms and conditions and its type
 - c. Layout planning and Optimisation
 - d. Advantages / dis-advantages of underground components
 - e. Dam Safety including Repair and Rehabilitation of Civil Structure, Sediment Management

- b) Development of Hydro Power Project
 - a. Introduction to major components of Hydro-electric Power Plant (E&M Components)
 - b. Layout of E&M Equipment - Surface & Underground Power Station.

- c) Types of Turbines (Kaplan, Francis, Pelton, Bulb, Propeller) and their usages in different Climatic and Geographical Conditions.
- d) Governing System and its Relationship with Guide Vane Opening and Closing.
- e) Pumped Storage HE Projects-Need of the Hour.
- f) Flood Control Mechanism and the Operating Mechanism of Crest Gates and Under Sluice Gates.
- g) Differences between Hydro and Thermal Power Plants on Technical and Commercial Comparison.
- h) Simulator Training Facility of Distributed Control System (DCS) and Protection System together with the operation of Crest Gates, Intake Gates, and Under Sluice Gates.

- i) Study of various components and systems within a hydro power plant that can be upgraded, such as turbines, generators, control systems, and auxiliary equipment.
- j) Techniques and methodologies for assessing the condition and performance of aging hydro power plants.
- k) Residual Life Assessment (RLA) Studies of Hydro Power Projects to assess and evaluate the condition and remaining life of critical component.
- l) Classification of R&M schemes based on scope of works:
 - i. Renovation and Modernisation (R&M)
 - ii. Restoration (Res)
 - iii. Uprating (U)
 - iv. Life Extension (LE)
- m) Approaches and best practices for upgrading and modernizing hydro power projects to enhance efficiency, reliability, and safety.
- n) Implementation of advanced automation and control systems for improved monitoring, operation, and maintenance of hydro power plants.
- o) Case studies of successfully renovated hydro power projects, along with the best practices, challenges faced and lessons learned.
- p) Commercial Aspects of R&M of Hydro Power plants i.e. Cost-benefit analysis, tariff determination etc
- q) Basics of Floating Solar PV on Water Bodies - Suitability of reservoir, Anchoring & Mooring Arrangements, Design parameters, Basics of Bathymetry Survey etc.'
- r) Environment Management
 - a. Environment, Forest & Wildlife Clearance
 - b. Environment & Social aspects of project
 - c. Preparation of Six Monthly reports on environmental aspects and yearly report to Forest and / or Wildlife clearances.
 - d. Filling up of yearly Environment Audit report to be submitted to SPCB and procedure for obtaining/ renewal of Consent to Operate.
 - e. Disaster Management Plan implementation and coordination
- s) **Topographical survey and mapping for planning**
 - a. Purpose & Scope of Survey
 - b. Types of Survey
 - c. Control Survey network.
 - d. Geodetic survey
 - e. Important Survey Equipment's.
 - f. Checking of Survey Data
 - g. Development of Maps
 - h. Map Projection
 - i. Guidelines of Survey work.
 - j. Horizontal Contour
 - k. Vertical Contour
 - l. Scale of Survey
 - m. Hydrological investigation

- t) Role of Geology in Hydro-electric Projects
Geo-Technical / Geo-Physical Investigations in Hydro Projects
- u) Hydro Power Potential Assessment
- a. Dependable year flows
 - b. Hydro Power Potential Study
 - c. Determination of Installed Capacity
- v) Rock Mechanics
- a. Introduction to Semiology and Earthquake, soil and materials
 - b. Introduction to Dams and Types of Dams Head works, Weirs and Barrages
 - c. Introduction to Water Conductor System
- w) Introduction to:
- a. Spillway / Outlet/ Intake Waterway
 - b. Fixation of MWL, Dead Storage Level
 - c. Diversion of River Water During construction
 - d. Surge Tank & Pressure Shaft
- x) Hydro Power Projects including Pumped Storage: Design & Engineering (Surface and Underground Power House)
- a. Role of Design & Engineering in Planning and Harnessing of Hydro Power Potential
 - b. Hydro Power Plant Turbines, Description, Construction, working Principle etc. including Selection of Turbine Components of Power Plants and their layout.
 - c. Basic dimensioning/calculation/location of E&M equipment with special emphasis on underground power house.
 - d. Valves: Theory & operation of different type of inlet valves (Butterfly, Spherical etc.)
 - e. Cycle efficiency and its calculation for PSP.
 - f. Peaking capability and economics.
 - g. Hydraulic Short circuit.
 - h. Ternary Pumped Storage Schemes.
 - i. Operation & Maintenance of Hydro Turbine including Pump Turbine (FSM & VSM), Generator set and associated auxiliaries such as:
 - Bus Duct.
 - Auxiliary Mechanical Services
 - Pumps
 - EOT Crane
 - Fire Detection and Protection System
 - Heating Ventilation and Air Condition System (HVAC)
 - Cooling Water System (CWS)
 - Compressed Air System
 - Lift
 - Insulating, Lubricating Oil Handling and purification System
 - Auxiliary Electrical Services
 - MV and LV Switchgear
 - Auxiliary Transformers
 - DC and UPS system
 - Illumination System
 - Power and Control Cable and Cable Trays
 - XLPE Cables
 - Emergency/ Standby Power Supply System (based on DG Set/ Battery Energy Storage System (as applicable))

APFC (Automatic Power Factor Correction (Capacitor)) Panels

- Drainage, Dewatering and Flood Protection System
- Instrumentation and Telecommunication System
- Security and Surveillance
- PA & Communication System
- DFIM (Doubly Fed Induction Motor) for PSP.
- Training on Basic dimensioning/calculation/location of E&M equipment with special emphasis on underground power house.
- Training on Metallurgical aspects/protection coating and their application and silt erosion etc.
- Training on Engineering, Procurement and Completion.
- Flood protection and safety measures.
- Various types of Gates (Intake, Surge Shaft and TRT Gate etc) including trash rake system.
- Discharge Measuring System.
- Gas Insulated/Air Insulated Switchgear and Pothead yard/Switchyard Equipment's.
- Power Transformer and Station/Unit Auxiliary Transformers.

y) **Hydro Mechanical Components of H.E Project and its importance**

- a. Hydraulic Gates & their operation
- b. Control system (in Dam intake, Spillway, draft tube, Surge shaft, Tail race Tunnel etc.)

z) **Generating Plant Equipment**

Generators, Transformer (Construction & types, working Principle etc.) Switchgear and other switchyard equipment.

aa) Introduction to Control & Protection System and Metering System -

- a. Importance of Sequential Protection and interlock
- b. Supervisory Control and Data Acquisition (SCADA) and Automation System
- c. Unit Protection and interlock
- d. Turbine & auxiliaries and vibration monitoring.
- e. Generator protection, under voltage, over voltage, differential, reverse power, under excitation, negative phase sequence and earthing.
- f. Transformer protection- differential over load, over fluxing, restricted earth fault, bucholz relay
- g. Types of motor and variable speed drive and control
- h. Types of pumps and their control
- i. Digital Static excitation system and digital governing system

bb) **GIS and pothead yard equipment**

Conventional Switchyard

cc) **Power Plant Auxiliaries, DC system**

Regulatory Framework & Operation of Power station

dd) Testing & Commissioning of Hydro Power Plants

a. Operation of hydro power plant

- i. Start and stop procedures
- ii. Active and reactive power sharing and frequency control.
- iii. Abnormal conditions

ee) Dam Operation

- a. Sediment Management
- b. Reservoir Flushing
- c. Early warning system
- d. Silt Measurement

ff) Energy Storage System

gg) Best Practices for Operation & Maintenance of Plant

hh) Project Scheduling and Monitoring

ii) Introduction to Construction material, Construction Equipments

Dam safety Monitoring and provision of eflow mechanism.

Understanding Fire safety and other hazard management as per ISO.

jj) Understanding of Occupational Health and Safety (OHS)

kk) Operation training

- a. Simulator
- b. Control room
- c. On site practicals

ll) On-Job maintenance of :

- a. Generator and its auxiliaries
- b. Transformers
- c. Auxiliaries
- d. Switch yard a
- e. Switchgear- HT/LT
- f. Control room
- g. AC/DC supply systems, station batteries and DG sets
- h. Data Acquisition System & DDC
- i. Analytic Instruments
- j. Instrument Air System & Actuators
- k. HT/LT motors
- l. Pumps
- m. Turbine
- n. Governing Equipment Main Inlet Valves
- o. cooling water system

mm) Suggestion: Appropriate training on Mechanical and Civil Side of Hydro Electric Power Plant may be included as per the organization needs.

(2) CURRICULUM FOR SUPERVISORS ASSISTING ENGINEERS ENGAGED IN THE OPERATION AND MAINTENANCE OF THE HYDRO POWER PLANT

a) Development of Hydro Power Project (Electrical)

- a. Power plant familiarization
- b. Introduction to major components of Hydro-electric Power Plant (E&M Components)
- c. Layout of E&M Equipment - Surface & Underground Power Station

- b) Governing System and its Relationship with Guide Vane Opening and Closing.
- c) Pumped Storage HE Projects-Need of the Hour.
- d) Flood Control Mechanism and the Operating Mechanism of Crest Gates and Under Sluice Gates.
- e) Differences between Hydro and Thermal Power Plants on Technical and Commercial Comparison.
- f) Simulator Training Facility of DCS and Protection System together with the operation of Crest Gates, Intake Gates, and Under Sluice Gates
- g) Study of various components and systems within a hydro power plant that can be upgraded, such as turbines, generators, control systems, and auxiliary equipment.
- h) Techniques and methodologies for assessing the condition and performance of aging hydro power plants.
- i) Residual Life Assessment (RLA) Studies of Hydro Power Projects to assess and evaluate the condition and remaining life of critical component.
- j) Classification of R&M schemes based on scope of works:
 - a. Renovation and Modernisation (R&M)
 - b. Restoration (Res)
 - c. Upgrading (U)
 - d. Life Extension (LE)
- k) Approaches and best practices for upgrading and modernizing hydro power projects to enhance efficiency, reliability, and safety.
- l) Implementation of advanced automation and control systems for improved monitoring, operation, and maintenance of hydro power plants.
- m) Case studies of successfully renovated hydro power projects, along with the best practices, challenges faced and lessons learned.
- n) Commercial Aspects of R&M of Hydro Power plants i.e. Cost-benefit analysis, tariff determination etc.
- o) Basics of Floating Solar PV on Water Bodies - Suitability of reservoir, Anchoring & Mooring Arrangements, Design parameters, Basics of Bathymetry Survey etc.'
- p) **Turbine and auxiliaries:**
 - a. Types of Turbines (Kaplan, Francis, Pelton) and their usages in different Climatic and Geographical Conditions
 - b. Fundamental principle of turbines and inlet valves
 - c. Details of various type of valves used in Hydro Power Stations
 - d. Theory and operation of turbines and inlet valves
 - e. Governing and protection of turbine
 - f. Operating procedures (start-up, running and shutdown)

- q) Various types of faults in generators, turbines and auxiliaries -analysis thereof.
- r) **Generator and auxiliaries:**
- a. Fundamental principle and working of generators
 - b. Excitation system
 - c. Automatic voltage regulator
 - d. HV, EHV, LT and control cables
 - e. Generator transformer connection
 - f. Protection of generators
 - g. Operating procedures (start up, running and shut down)
 - h. All Station and Unit Auxiliaries and their equipments
- s) Engineering drawing and practice
- t) Principle and working of alternating current and direct current generators, motors, their speed characteristics, controls.
- u) Electrical appreciation- correct and Appropriate use of electrical tools like Megger, tong testers, multi-meters, insulation testing equipment, earthing and its importance.
- v) Bearings- types, installation and removal procedures and maintenance, clearance and tolerances, oil seals- types, applications with clearances.
- w) Lubrication and cooling principles.
- x) Station instrumentation and controls, Basics of SEM and its operation principles, downloading and analysis of reading. Operation of DCD system.
- a. Power station electrical auxiliary system - general aspects and basic flow diagrams, etc.
 - b. Station lighting, power supply and distribution boards
 - c. Station batteries and battery charging system
 - d. Unit and station transformers
 - e. DG sets and their maintenance
 - f. Fire Safety
 - g. Basics of fire-fighting system and their maintenance.
 - h. Operation, selection and handling of different type of fire extinguishers.
 - i. Welding : Types & Usages,
 - j. Understanding Fire safety and other hazard management as per ISO
- y) On job Training in above areas with hands on practicals
- z) Disaster Management Plan implementation and coordination
- aa) Understanding of Occupational Health and Safety (OHS)
- bb) Suggestion:
Appropriate training on Mechanical and Civil Side of Hydro Electric Power Plant may be included as per the organization needs.

(3) CURRICULUM FOR TECHNICIANS ASSISTING SUPERVISORS ENGAGED ON THE ELECTRICAL SIDE OF THE HYDRO ELECTRIC POWER PLANTS

- a) Classroom Training
- b) Operation and general aspects of annual maintenance of generators and auxiliaries
 - a. Generator and its dry out
 - b. Excitation system
 - c. AVR
- c) Operation and general maintenance of common electrical auxiliaries
 - a. Station supply
 - b. Batteries and chargers, DC distribution boards and emergency lighting system
 - c. Motor winding and repairs
 - d. Understanding of electrical panel wiring
 - e. PLCC system
 - f. EOT crane
- d) Study of various components and systems within a hydro power plant that can be upgraded, such as turbines, generators, control systems, and auxiliary equipment.
- e) Techniques and methodologies for assessing the condition and performance of aging hydro power plants.
- f) Residual Life Assessment (RLA) Studies of Hydro Power Projects to assess and evaluate the condition and remaining life of critical component.
- g) Classification of R&M schemes based on scope of works:
 - a. Renovation and Modernisation (R&M)
 - b. Restoration (Res)
 - c. Up-rating (U)
 - d. Life Extension (LE)
- h) Approaches and best practices for upgrading and modernizing hydro power projects to enhance efficiency, reliability, and safety.
- i) Implementation of advanced automation and control systems for improved monitoring, operation, and maintenance of hydro power plants.
- j) Case studies of successfully renovated hydro power projects, along with the best practices, challenges faced and lessons learned.
- k) Commercial Aspects of R&M of Hydro Power plants i.e. Cost-benefit analysis, tariff determination etc
- l) Basics of Floating Solar PV on Water Bodies - Suitability of reservoir, Anchoring & Mooring Arrangements, Design parameters, Basics of Bathymetry Survey etc.'
- m) Operation and maintenance of transformers including oil filtration
- n) Types of Turbines (Kaplan, Francis, Pelton) and their usages in different Climatic and Geographical Conditions
- o) Governing System and its Relationship with Guide Vane Opening and Closing.
- p) Pumped Storage HE Projects-Need of the Hour.
- q) Flood Control Mechanism and the Operating Mechanism of Crest Gates and Under Sluice Gates.
- r) Differences between Hydro and Thermal Power Plants on Technical and Commercial Comparison.

- s) Outdoor switch yard equipment such as isolators, circuit breakers and contactors, earthing switches, CT, CVT, LA
- t) Indoor switch gear system
- u) Alarm systems - visual and audible
- v) Earthing and neutral grounding: necessity of methods for safety while handling electrical equipments. Reading electrical circuit diagrams
- w) Meggering and testing of electrical equipment, wiring and cables
- x) Maintenance of electrical switchgears
- y) Fuses-rewirable types, cartridges type, high rupturing capacity fuse, constructional features of fuse and fuse sockets, knife type high rupturing capacity fuses, use of pullers for insertion and removal, color code for fuse ratings.
- z) Motor starters and their applications- direct-on-line, star delta, rotor resistance, contactors and relays
- aa) Voltmeters, ammeters, watt meters, energy meters, meggers, multi-meters, tong testers and general information about their use
- bb) Laying and jointing of cables of voltage up to 250 V and exceeding 250 V but not exceeding 650 V
- cc) Panel wiring methods, connections, earthing, and principles of operation of small distribution transformers.
- dd) Protection relays, current and potential transformers, purposes, connections and use

a) Practicals:

- a. Interpretation of instrument reading and accurate logging.
- b. Workshop practices, making of spare parts, welding, gas cutting, pipe fitting methods.
- c. Introduction to various tools and tackles
- d. Shaft Alignment methods
- e. Vibrational general causes effects, remedies, measurement and balancing.
- f. Maintenance and testing of disturbance fault recorder, event sequence recorder, digital relay.
- g. Pressure gauges, Level gauges, Temperature indicator.
- h. Transfer Oil Testing.
- i. Meggering and testing of electrical equipments.
- j. Disaster Management Plan implementation and coordination
- k. Understanding Fire safety and other hazard management as per ISO
- l. Understanding of Occupational Health and Safety (OHS)
- m.

b) Suggestion:

Appropriate training on Mechanical and Civil Side of Hydro Electric Power Plant may be included as per the organization needs.

17. Renewable Energy General Module

1. The Real challenges: Renewable & Solar Energy

Duration : 03 Hours

- (1) Transition Journey of Renewable Energy, Global & Indian Renewable Energy Scenario: Target & Achievement. Challenges in Grid Integration, Forecasting & Demand Response. Overview of all kind of Renewable Energy, Overview of solar PV system and latest trends in solar PV (Photo Voltaic) technologies, design aspects of Solar PV system.
- (2) Overview of Bifacial Solar PV Technology and Floating Solar PV Technology.
- (3) Historical Development in Wind Turbine Technology & its design aspects, Wind Resource assessment.
- (4) Grid Stability, Microgrid Technology, DER, Smart Inverter & Quality of Power.
- (5) Hands On-Practice of Multifunctional Simulator (Solar & Wind).

2. Journey towards Energy Transition & Grid Edge Technologies for Sustainability

Duration: 06 Hours

- (1) Concept of Clean & Green Energy, Clean Energy Transition: Objective, Opportunity and Potential.
- (2) Requirement, Relation & Reproduction (3R) Tools & Techniques, Energy Security, Area's of Energy Transition and Methodology for Energy Transition, Grid Edge, Adaptive grid to Adaptive Prosumer, Objective of Energy Communities.
- (3) Overview of Virtual Power Plants and P2X. Concept of Green Energy Building & Smart Building, Energy Storage, Hybrid Energy.
- (4) Case studies on Global Energy Transitions.

3. Resource Optimization: Hydro & Pumped Storage Technologies

Duration : 06 Hours

- (1) Hydropower Development in India, Hydropower Plant Equipment & Plant Operation, Operational difference in R-O-R Hydro plant with balancing reservoir & Pump Storage plant.
- (2) Role of hydro Power Plant for Grid Stability and balancing. Design Optimization and Challenges in Construction of Hydro Projects.
- (3) Various key indicators for design of Hydro Power Projects. Risk Assessment in Hydro Power Plant.
- (4) Optimal utilization of Pump Storage for Grid Balancing along with various case studies.
- (5) Hand-On-Practice on Hydro Simulator.

4. Transition towards the Energy Technology: Storage, Integration & Modern dynamics

Duration : 06 Hours

- (1) Carbon Neutrality & Deep-Decarbonization, Transition towards Modern Grid to Flexible Grid, Waste to Energy- Waste and Society, Global Waste to Energy Technologies (Case studies).
- (2) Overview of Fuel Cell & Ultracapacitor : Types & Design of Fuel Cells, Economy of fuel Cells.
- (3) Ultracapacitor & Its Types, Design and Commercial Viability for Ultracapacitors, Hydrogen Energy & Green Hydrogen, Overview of E-Mobility & Electric Vehicle, Biomass and Bio-energy technologies, Flue Gas Desulphurization (FGD), Methods for GHG reduction.

18. CURRICULUM FOR ENGINEERS/SUPERVISORS ENGAGED IN THE OPERATION AND MAINTENANCE OF RENEWABLE ENERGY GENERATING STATION

S.No	Topics	Sessions
	RENEWABLE ENERGY -Solar	
01	Energy scenario, Smart Grid and Microgrids, Renewable Energy Introduction	02
02	Solar policies and latest Govt guidelines and its impact, regulatory aspects, techno economical aspects	01
03	Introduction to Solar Energy, Fundamentals of Solar Radiation, Geometry & Solar PV systems and Solar Parks	02
04	Financial models, DPR and award of contracts	01
05	Solar PV Plant Energy Estimation, Shading analysis & Array layout	01
06	Solar PV module: General, type, construction, components, testing (Physics behind monocrystalline, poly crystalline and thin-film, Perovskite crystal, bifacial), degradation over time and Module mounting arrangement (MMS)	01
07	Solar Inverters, Transformer, HT and LT SWGR, AC and DC cables, Power Evacuation: Switchyard, transmission line and Metering for solar PV, Earthing System, Lighting protection system	01
08	SCADA, IoT system design and integration, Weather monitoring station, Solar plant control and protection	01
09	Module Cleaning system	01
10	PG test	01
11	Roof Top solar PV systems (anchor design, flexible joints, mooring design, impact of wind-force analysis)	01
12	Floating solar (anchor design, flexible joints, mooring design, impact of wind-force analysis)	02
13	Design aspect of solar thermal technologies and characterization, Economics and energy economics of solar thermal applications: Basics and techno-commercial appraisal of solar thermal power plant & cost calculation	01
14	Performance Evaluation Parameters, Solar thermal testing and standards (BIS)	01
15	Operation and types of solar concentrators; Integration of solar collectors with process heat systems	
16	Different types of solar thermal power plants, Concentrator optics and tracking, Modelling and optimization, Solar hybrid energy systems; Polygeneration	01
	RENEWABLE ENERGY-Wind	
1	Introduction to Wind Energy and Global Wind Energy Scenario, various Government policies, Economic and Financial Analysis of Wind Power Development	01
2	Wind Resource Assessment and its Techniques, Wind Data Collection, Processing, Validation, Analysis and Reporting, Site Selection criteria for installing wind monitoring Stations	01
3	The Aerodynamic Aspects of Wind Turbine, Design Aspects of Wind Turbine	01
4	Wind Turbine Gear Box and Drive Train and Generator Concepts	01
5	Wind Turbine Tower and Foundation Concepts	01

6	Control and Protection system of Wind Turbine	01
7	International Standards of Wind Turbine, Type Certification of Wind Turbine, Wind Turbine Testing and Measuring Techniques, Power Curve Measurement and Safety and Function Test	01
8	Installation and Commissioning of Wind Turbine	01
9	Operation and Maintenance aspects of Wind Farms	01
10	Environmental aspects of Wind Turbine Technology	01
11	An Overview of Offshore Wind Energy	01
	Integration of RE generation and Battery storage	
1	Issues with the Grid Integration of Renewable Energy Systems	01
2	Connectivity procedures and system study requirements for RE projects	01
3	Introduction, world/India energy storage overview/Storage strategy/Indian installations	01
4	Energy storage technology overview, types, and applications	01
5	Lithium-ion batteries: components/working /raw materials/ commercial systems Advancements in battery technologies: improvements in cycle life and energy density	01
6	Batteries for electric vehicles, stand-alone, grid connected systems, Battery sizing for standalone and grid Applications and Redox flow batteries for large scale storage applications Beyond lithium-ion batteries: metal-ion batteries (sodium/potassium/calcium etc.), Battery recycling and circular economy	01
	Small Hydropower Generation	
	Various Small Hydropower Scheme, Power Potential, Civil components of SHP, Dam, Barrage, Weir, Desilting chamber, Power channel, Forebay, Penstock, Tailrace channel, Mini and Micro hydro Power (MHP) Generation: Classification of SHP, Selection of E&M equipment of SHP, Power house layout design, DPR Preparation, Types of Hydro Turbines, Constructional detail and operation & Maintenance, Hill curve & operating characteristic curve of hydro Turbine, Main Inlet Valve, Hydraulic oil System, Cooling water System, Drainage & Dewatering System, Fire Protection System, HVAC System & other mechanical auxiliary system, Constructional detail and O&M of hydro generator, Generator transformer, Control & Protection System & Other electrical auxiliary system.	
	Bio Mass Technology, Concept of Co- Generation and Waste Energy Recovery, Geothermal, Tide, Wave Energy, Hydrogen Energy, Fuel Cell	
	Biomass Generation and utilization, Properties of biomass, Agriculture Crop & Forestry residues used as fuels, Biochemical and Thermo-chemical Conversion, Combustion, Gasification, Biomass gasifiers and types etc., Applications of Gasifiers to thermal power and Engines, Biomass as a decentralized power generation source for villages, Concept of Bio-energy, Thermo-chemical Conversion, Bio-Chemical Conversion, Bio-fuels, Bio-based Chemicals and Materials, Co-generation, Tri-generation & Waste Energy Recovery, Waste Heat Recovery, Geothermal, Tide and Wave Energy, Hydrogen Energy, Storage of Hydrogen, Fuel Cell.	
	Procurement Process & Material Management, Renewable Energy Financial modeling, Project Financing Entrepreneurship	
	Purchase Management, Materials Management Module in SAP system, CVC guidelines on procurement, Purchasing Process, Buying at Right Price, Pre-requisite of comparative bidding, Broad type of tenders, Tender	

	conditions, framing of Q R(Qualifying requirements), Tendering procedure & Tender opening, Tender/BID Evaluation, Loading for deviations, Price/Cost analysis, Placement of Orders, Lead time analysis. Pricing Agreement (Rate Contract), Various price basis. Vendor enlistment & Source standardization Expediting of supply from vendor, closing of POs.	
	<p>CONTRACTS MANAGEMENT: Preparation & approval of Scope of work & cost estimate. Budgeting. General & Special Contract Conditions, Qualifying Requirements. Mode of tendering, Single part bid/ two part bids, Tender Opening, Preparation of comparative statement, Technical Evaluation of bids in line with considering deviations & cost compensation, Placement of Award, Signing of agreement, Different Bank Guarantees, Post Award Activities: Role & Responsibilities of Engineers-in-charge, First RA bill. Final bill & closing of contract, Arbitration cases</p> <p>Basics of Finance in Power Sector, Capital Budgeting, Capital Budgeting, Capital Budgeting, Sources of Finance, Working Capital Management, Financial Statements, Financial Statement Analysis, Financial Statement Analysis, Project Financing, Basics of Financial Modeling, Financial Modeling – Case Study, Renewable Energy Planning in India, Environmental Issues, Regulatory Issues, Health Issues, Entrepreneurship, Understanding the business environment of Renewables in India.</p>	

Practical session – 1 Days

Site visit to Solar & wind plant at nearby site

- a) Demonstration of technical aspects – 01 day
- b) Demonstration of O & M Practices – 01 Day

19. CURRICULUM FOR TECHNICIANS ENGAGED IN OPERATION & MAINTENANCE OF SOLAR PV SYSTEMS

1. Renewable Energy Scenario in India
2. Electrical Safety Electrical & Safety Rules
3. Simple First Aid, General safety of tools and equipment
4. Personal Protective Equipment
5. Fire extinguishers, Type of fire extinguishers
6. Electricity Basics
7. Fundamental of earthing system
8. Solar PV module Fundamentals - Types of modules and its applications, PV components and configuration etc.

9. Introduction to Solar Photovoltaic, Basic Principle of Photovoltaic Tech.
10. PV System Sizing - series & parallel Array
11. Fundamental temperature coefficients - Current, voltage and power fundamentals
12. Performance analysis and troubleshooting monitoring of generation per string incoming & outgoing power at junction box & Inverter level.
13. Requirement and Uses of Tools & Tackles
14. Basic knowledge of Ammeter Voltmeter, clamp meter, tong tester Irradiance sensor temperature sensors
15. Cable tray & Cable laying
16. SCADA & Control System
17. End termination of power cable
18. (LT/ HT) Commissioning & testing
19. Structure erection
20. Battery installation & Maintenance
21. Check list preparation
22. Pre -requirement of installation of sub-station equipment
23. Basics and erection of transformers, pole erection and Stringing
24. Foundation- reinforcement & Shutting
25. Operation & Maintenance
26. Soft & Entrepreneurship Skills

Practical session – 1 Days

Site visit to Solar & wind plant at nearby site

- a) Demonstration of technical aspects – 01 day
- b) Demonstration of O & M Practices – 01 Day

Solar PV Lab and Solar PV Trainer /Simulation Kit:

1. 10 KWp Grid connected Roof Top Solar PV Installation (Mono /Poly Crystalline Technology & Thin film Technology) with 10 Kw Inverter,
2. SCADA Monitoring Facility, Pyranometer, Data Logger, Temperature sensor & Irradiance Sensor etc.
3. Measuring Devices like Megger, Clamp Meter, Multimeter, Hydro Meter, Vernier Caliper, Measuring Tape Etc.

4. Fitting Tools like Double ended Flat spanner, Double End Ring Spanner, Combination Pliers, Side Cutting Pliers, Nose pliers, Nose pliers, wire Stripper, hand Crimping Tools, Cable cutter, Screw Driver etc.

5. Safety Tools like Safety Helmets, safety Belt, Nose mask, Safety Goggles, PVC Hand Gloves

CENTRAL ELECTRICITY AUTHORITY

Application Form-A

(To be Filled for Last Financial Year and each page to be signed by Head of the Institute)

Application Form for Statutory Recognition of Training Institutes under Regulation 7 of Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023 pertaining to personnel engaged in O&M of Generation Station

Name of the Training Institute:

Permanent Account Number (PAN) of the Training Institute:

Complete address: _____

Name of the Head of the Training Institute:

Telephone nos. Office: _____ **Residence:** _____

Email address: _____ **Mobile no.** _____

Website of the Institute: _____

Name of the owner of the Training institute:

GENERAL INFORMATION

1. **Field of Training** : (i) Thermal Generation (ii) Hydro Generation (iii) Renewable Energy Generation

2. **Category of Institute** : (Tick mark appropriately)

Category -I : Training for Engineers	
Category -II : Training for Supervisors	
Category -III : Training for ITI qualified / Non-qualified technicians	

3. Training Institute owned by (Tick Appropriately): Central Government/ State Government/ Private/ Others.

4. **Mandatory Requirement** :

Whether all the mandatory conditions given below are met? : Yes/No

Sr No.	Mandatory Conditions	Yes/No
(1)	The training institute shall have a full time Principal/Director and teaching staff.	
(2)	There should be a separate building which shall be solely used for the purpose of training. The building shall either be owned by the institute or on lease. However, in case the building is on lease then the lease period shall be more than the period of recognition.	
(3)	The training institute shall give an undertaking that on recognition for 3 years initially, the institute shall follow the curriculum as per these guidelines	
(4)	The training institute shall have the facilities of providing training on simulator and slide shows & multimedia etc. The training institute shall have institutional tie up for simulator training/labs/workshops, if not having in-house.	
(5)	The training institute shall have CCTV facility at the examination hall for conducting the term end exam. The training institute may have tie up with independent agency for conducting the exam which shall have CCTV facility at the examination hall for conducting the exam.	
(6)	The training institute shall have basic medical facilities and high Speed Internet facilities in its premises.	
(7)	The training institute shall score a least 60% in the evaluation criteria for getting its recognition from the Authority.	
(8)	The budget provision and control of expenditure for training program shall be distinctly and exclusively earmarked for the institute.	

5. Annual Training Capacity of the Institute (Days) :

6. Annual Budget provisions for training during last financial year:

(Rupees in lakh)

Year	Allocated Budget	Budget Utilized	% Budget Utilized
F.Y.			

7. Infrastructure (The information shall be related with the Training Institute):

(1) Details of Classrooms (including seminar/syndicate rooms/computer rooms) in the training institute:

No. of Classrooms	Seating Capacity	Whether A-V aids facilities provided	Whether Live streaming capability	Remarks
(1)	(2)	(3)	(4)	(5)
		Yes/No	Yes/No	

(2) Laboratories/Workshops including computer labs

Sl. No.	Type and no. of Laboratory/Workshops

(3) Details of Hostel Facilities in the training institute :

No. of Rooms x Beds*	Hostel Capacity (Total no. of beds)	No. of days for which hostel is available Annually	Annual occupancy during the year (Mandays i.e. annual sum of no. of trainees stayed each day)	% Annual occupancy

*e.g. 24x2 stands 24 twin-bed rooms, and 13x1 for 13 single-bed rooms.

(4) Details of Simulators:

Number and details of Simulators (Own/Tie-up) for training relating to Generation to be attached.

(5) Details of Library/ e-library:

e- Library Yes/No

Details of Books	Nos. (pls mention whether available in Library or E-Library)
Technical books	
Standards-BIS,IEC etc	
CEA Regulations	
SERC regulations	
No. of Journals	

(6) Model Room Yes/No

If yes, then enclose the number of models and their list.

(7) Multimedia training packages (attach list as per format below):

Sl. No.	Subject	Numbers	Remarks

(8) Whether the training institute has e-integration with other Training Institute within the organization or with other organizations: Yes/ No

If yes, then attach the list with the details.

(9) Whether the training institute has linkage with the generating station in respect of organizing and monitoring the on-job training: Yes/ No

If yes, then furnish the name of the organization where on-job training imparted.

(10) Do you have an officer designated as an On-job Trainer? Yes/No

If yes, then give the name and designation of the officer.

(11) Auditorium/Conference Hall Yes/No

If yes, then mention Seating capacity

(12) Reprographic Facilities /Resource Centre Yes/No

If yes, attach the list with details.

(13) Quality of Infrastructure as rated by the applicant/ institute itself as excellent / very good/ good:

(a) Quality of Maintenance: (Excellent / Very Good/ Good)

(b) Quality of Air Conditioning: (Excellent / Very Good/ Good)

(c) Maintenance of cleanliness and hygiene: (Excellent / Very Good/ Good)

(d) Other facilities (please tick among the following):

- (i) Transport
- (ii) Recreation (Indoor/ Outdoor)
- (iii) Laundry services
- (iv) Mess/ Canteen
- (v) Medical facilities
- (vi) High Speed Internet
- (vii) Gym
- (viii) Others

8. Faculty:

(1) Details of Faculty (Core Faculty + Empaneled Faculty + Guest Faculty) for training shall be furnished by the applicant for the financial year. The list of faculty (Core Faculty / Empaneled Faculty / Guest Faculty) to be submitted in the format given below:

Sl. No.	Name of Faculty member	Qualification	Experience	Specialization
A. Core faculty (as defined in the Guidelines)				
1.				
2.				
B. Empaneled faculty (as defined in the Guidelines)				
1.				
2.				
C. Guest faculty / Experts (as defined in the Guidelines)				
1.				
2.				

(2) The details mentioned at para (1) above regarding faculty to be summarized as per the table given below:

Total	Numbers			Qualification wise(nos.)				No. of Core Faculty trained during the year
	Core*	Empaneled*	Guest*	Diploma	Degree	PG	Ph.D.	

* as defined in the guidelines

(3) Experience:

- (i) No. of faculty having experience more than 5 years but less than 10 years:
- (ii) No. of faculty having experience more than 10 years:

(4) Details of depth of Knowledge of Core faculty

S. No.	Area	Details
(1)	Papers Published in conference or seminars by core faculties	1. 2. 3.
(2)	core faculties Empaneled with other institutes	1. 2. 3.
(3)	Membership of National or International body of the training institute	1. 2. 3.

	
(4)	Working models or simulation models made by core faculties	1. 2. 3.

9. Training Courses

(1) The courses conducted during the last financial year to be provided in the format given below:

	Name of course	Modules / topics covered	Duration (From-To)	No. of Trainees	Total Days
	Courses relevant to Power Sector 1. 2. Sub-total				
	Training on Simulator 1. 2. Sub-total				
	On-job training at Sub-Station 1. 2. Sub-total				
	Total				

(2) The no. of courses and the no. of person trained during the last F.Y. to be furnished as per the table given below:

Year	Number of courses	Persons trained	
		Nos.	(Days)
F.Y.			

(3) Break up of total training days during the last financial year:

Sl. No.	Type of Course	Persons trained	Days
1.	Theory Course *		
2.	Simulator training		
3.	On-job training		

*Online training shall be included in the *Theory Course*

10. Training methodology

(i) Classroom lectures	Yes/No	} (Enclose the Details)
(ii) Group Discussion Session	Yes/No	
(iii) On-job Training	Yes/No	
(iv) Case Studies and presentation By each trainee	Yes/No	

11. Instructional capability

- (1) Has the Core faculty been adequately trained in the instructional technique for the F.Y.? Yes/No
If yes,

Name of the core faculty member	Training in instructional techniques			
	At Institute (Name)	Period		Days
		From	To	

- (2) Whether the digital handouts related to course content are prepared for each lecture and given to trainees. Yes/No
- (3) Do the digital handouts clearly indicate the objectives of the lesson, various elements into which the lesson has been broken relevant to syllabus. Yes / No
- (4) Is the lecture supported by the objective type questions? Yes/No
- (5) Feedback from trainees on (attach a copy of sample feedback)
- | | |
|---------------------------|--------|
| (i) Each faculty | Yes/No |
| (ii) Each Training Module | Yes/No |
| (iii) Training Need | Yes/No |
| (iv) Institute Facilities | Yes/No |

Date:

Signature of head of the Training Institute with Office Stamp/Seal

CENTRAL ELECTRICITY AUTHORITY

Application Form-B

(To be filled for last three financial years each, separately and each page to be signed by Head of the Institute)

Application Form for RENEWAL of Statutory Recognition of Training Institutes under Regulation 7 of Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023 pertaining to personnel engaged in O&M of Generation Station

Name of the Training Institute:

Permanent Account Number (PAN) of the Training Institute:

Complete address: _____

Name of the Head of the Training Institute:

Telephone nos. Office: _____ **Residence:** _____

Email address: _____ **Mobile no.** _____

Website of the Institute: _____

Name of the owner of the Training institute:

GENERAL INFORMATION

1. Year of Recognition of Training Institute (attach the Certificate of Recognition):

2. **Field of training** : (i) Thermal Generation (ii)Hydro Generation (iii) Renewable Energy Generation

3. **Category of Institute : (Tick mark appropriately)**

Category -I : Training for Engineers	
Category -II : Training for Supervisors	
Category -III : Training for ITI qualified / Nonqualified technicians	

4. Training Institute owned by (Tick Appropriately): Central Government/ State Government/ Private/ Others.

5. **Mandatory Requirement :**

Whether all the mandatory conditions given below are met?

Sr No	Mandatory Conditions	Yes/No
(1)	The training institute shall have a full time Principal/Director and teaching staff.	
(2)	There should be a separate building which shall be solely used for the purpose of training. The building shall either be owned by the institute or on lease. However, in case the building is on lease then the lease period shall be more than the period of recognition.	
(3)	The training institute shall have at least 2 faculties (core/empaneled/guest) in relevant specialized topics/subjects of the curriculum given in these guidelines.	
(4)	The training institute shall have the facilities of providing training on simulator and slide shows & multimedia etc. The training institute shall have institutional tie up for simulator training/labs/workshops, if not having in-house.	
(5)	The training institute shall conduct induction course and refresher course as per the curriculum given in these guidelines	
(6)	The training institute shall have basic medical facilities or shall have tie up and high speed internet facilities in its premises.	
(7)	The training institute shall have CCTV facility at the examination hall for conducting the term end exam. The training institute may have tie up with independent agency for conducting the exam which shall have CCTV facility at the examination hall for conducting the exam.	

(8)	The training institute shall score a least 60% in the evaluation criteria for getting its recognition from the Authority.	
(9)	The budget provision and control of expenditure for training program shall be distinctly and exclusively earmarked for the institute.	

6. Annual Training Capacity during the financial year (in days)

7. Annual Budget provisions for training:

(Rupees in lakh)

Year	Allocated Budget	Budget Utilized	% Budget Utilized
F.Y.			

8. Infrastructure (The information shall be related with the Training Institute):

(1) Details of Classrooms (including seminar/ syndicate rooms/ computer rooms) in the training institute:

No. of Classrooms	Seating Capacity	Whether A-V aids facilities provided	Whether Live streaming capability provided	Remarks
(1)	(2)	(3)	(4)	(5)
		Yes/No	Yes/No	

(2) Laboratories/Workshops including computer labs

Sl. No.	Type of Laboratory/Workshops

(3) Details of Hostel Facilities in the training institute:

No. of Rooms x Beds*	Hostel Capacity (Total no. of Beds)	No. of days for which Hostel is available Annually	Annual occupancy during the year (Mandays i.e. annual sum of no. of trainees stayed each day)	% Annual occupancy

*e.g. 24x2 stands 24 twin-bed rooms, and 13x1 for 13 single-bed rooms.

(4) Details of Simulators:

Number and details of Simulators for training relating to Transmission systems to be attached.

(5) Details of Library/ e-library:

e- Library : Yes/No

Details of Books	Nos (pls mention whether available in Library or E-Library)
Technical books	

Standards-BIS,IEC etc	
CEA Regulations	
SERC regulations	
No. of Journals	

(6) Model Room Yes/No

If yes, then enclose the number of models and their list.

(7) Multimedia training packages (attach list as per format below):

Sl. No.	Subject	Numbers	Remarks

(8) Whether the training institute has e-integration with other Training Institute within the organization or with other organizations: Yes/ No

If yes, then attach the list with the details.

(9) Whether the training institute has linkage with the generating station in respect of organizing and monitoring the on-job training: Yes/ No

If yes, then furnish the name of the organization where on-job training imparted.

(10) Do you have an officer designated as an On-job Trainer? Yes/No

If yes, then give the name and designation of the officer.

(11) Auditorium/Conference Hall Yes/No

If yes, then Seating Capacity

(12) Reprographic Facilities /Resource Centre Yes/No

If yes, attach the list with details.

(13) Quality of Infrastructure as rated by the applicant/ institute itself as excellent / very good/ good:

(e) Quality of Maintenance: (Excellent / Very Good/ Good)

(f) Quality of Air Conditioning: (Excellent / Very Good/ Good)

(g) Maintenance of cleanliness and hygiene: (Excellent / Very Good/ Good)

(h) Other facilities (please tick among the following):

(i) Transport

(ii) Recreation (Indoor/ Outdoor)

(iii) Laundry services

(iv) Mess/ Canteen

(v) Medical facilities

(vi) High Speed Internet

(vii) Gym

(viii) Others

(14) Quality of training imparted

- (i) Overall rating of the institute by the previous trained batches.
- (ii) Overall Test scores achieved by the trainees. (Course Type-wise)
- (iii) Percentage of Course Completion by the trainees. (Course Type-wise)

9. Faculty:

(1) Details of Faculty (Core Faculty + Empaneled Faculty + Guest Faculty) for training shall be furnished by the applicant for the financial year. The list of faculty (Core Faculty / Empaneled Faculty / Guest Faculty) to be submitted in the format given below:

Sl. No.	Name of faculty member	Qualification	Experience	Specialization
A. Core faculty (as defined in the Guidelines)				
1.				
2.				
B. Empaneled faculty (as defined in the Guidelines)				
1.				
2.				
C. Guest faculty / Experts (as defined in the Guidelines)				
1.				
2.				

(2) The details mentioned at para (1) above regarding faculty to be summarized as per the table given below:

Total	Numbers			Qualification wise(nos.)				No. of Core Faculty trained during the year
	Core*	Empaneled*	Guest*	Diploma	Degree	PG	Ph.D.	

* as defined in the guidelines

(3) Experience:

- (i) No. of faculty having experience more than 5 years but less than 10 years:
- (ii) No. of faculty having experience more than 10 years:

(4) Details of depth of Knowledge of Core faculty

S. No.	Area	Details
(1)	Papers Published in conference or seminars by core faculties	1. 2. 3.
(2)	core faculties Empaneled with other institutes	1. 2. 3.

	
(3)	Membership of National or International body of the training institute	1. 2. 3.
(4)	Working models or simulation models made by core faculties	1. 2. 3.

10. Training Courses

(1) The courses conducted during the last three years as per the curriculum mentioned in these guidelines, to be provided in the format given below:

	Name of course	Modules / topics covered	Duration (From-To)	No. of Trainees	Total Days
	Name of Course(Induction/Refresher) 1. 2. Sub-total				
	Training on Simulator 1. 2. Sub-total				
	On-job training at sub-station 1. 2. Sub-total				
	Total				

(2) The no. of courses and the no. of person trained during the financial year to be furnished as per the table given below:

Year	Number of courses	Persons trained	
		Nos.	(Days)
F.Y.			

(3) Break up of total training days during the financial year:

Sl. No.	Type of Course	No. of Persons trained.	Days
1.	Induction		
2.	Refresher		
3.	Simulator training		
4.	On-job training		

*Online training shall also be included in these courses

Courses are in line with the Guidelines-

yes/No

11. Training methodology

- (i) Classroom lectures
- (ii) Group Discussion Session
- (iii) On-job Training
- (iv) Case Studies and presentation
by each trainee

Yes/No

Yes/No

Yes/No

Yes/No

(Enclose the Details)

12. Instructional capability

(1) Has the **Core** faculty been adequately trained in the instructional technique in the F.Y? Yes/No

If yes,

Name of the core faculty member	Training in instructional techniques			
	At Institute	Period		Days
		From	To	

(2) Whether the digital handouts related to course content are prepared for each lecture and given to trainees.

Yes/No

(3) Do the digital handouts clearly indicate the objectives of the lesson, various elements into which the lesson has been broken relevant to syllabus? Yes / No

(4) Is the lecture supported by the objective type questions?

Yes/No

(5) Feedback from trainees on (attach a copy of sample feedback)

(v) Each faculty

Yes/No

(vi) Each training module

Yes/No

- | | | |
|--------|----------------------|--------|
| (vii) | Training need | Yes/No |
| (viii) | Institute facilities | Yes/No |

13. Whether the training institute is following the curriculum provided in the CEA guidelines?
Yes / No

14. Whether the training institute is conducting the term end exam as mentioned in the CEA guidelines?
Yes / No

15. Specific details for the Training program for the trainees to be provided for each program for the F.Y.:

- (1) Average score obtained by the trainees in **Induction Course Term End Exam.**
- (2) Average score obtained by the trainees in **Refresher Training Exam**

Date:

Signature of head of the Training Institute with Office Stamp/Seal

Formats/Forms for Record of Induction training of the Engineers/Supervisors/ Technician of the Generation Station (To be maintained by the concerned Generation Utility/Organization)

S. No	Name of the Employee	Aadhar No.	Designation % Section/ Division of Posting	Date of Engagement	Name of the Training Institute	Course Name	Certificate No. & Date	Score obtained in Term-End Exam (in %)

Certificate by the Head of the Generation System

It is certified that all the engineers/supervisors engaged have been trained as per the guidelines issued by Central Electricity Authority in line with the Regulation 7(4) of (Measures relating to Safety and Electric Supply) Regulations, 2023. The records of their assessment has been maintained as per the format mentioned in the Guidelines.

Date

Head of the Generation system

Certificate by the Head of Training Institute

This is to certify that Shri/Ms._____ Aadhar no._____ has successfully completed Training Course in**Generation** which is in accordance with the Curriculum mentioned in the Guidelines issued by Central Electricity Authority in line with the Regulation 7(4) of the Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023.

Date

Head of the training Institute.