EPC PACKAGE FOR LARA SUPER THERMAL POWER PROJECT, STAGE-II (2x800 MW)
Amendment No. 02 to Technical Specifications Section-VI of Bidding Document No.: CS-9587-001R-2

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Section / Part	Sub-Section	Clause No.	Page No.		
TG1-01	VI/A	VI/ Chapter-02	Group C: Mandatory Spares 1. Main Turbine (xxv)	12 of 31	Valve Seat for HPSV, HPCV, IPSV, IPCV, HP Bypass Valve, HP Bypass Spray Valves, HP Bypass Spray Isolation Valve	Valve Seat for HPSV, HPCV, IPSV, IPCV, HP Bypass Valve, HP Bypass Spray Valves, HP Bypass Spray Isolation Valve **(Applicable wherever valve seats are envisaged as separate item)**
TG1-02	VI/A	VI/ Chapter-02	Group C: Mandatory Spares 5(ii)	13 of 31	Shell side safety relief valve for the following: (ii) All LP heater	Shell side safety relief valve for the following: (ii) All LP heater **(as applicable)**
TG1-03	VI/B	A-01	2.02.01 (i)	45 of 101	**Condenser** (i) Design, manufacturing and testing as per Heat Exchanger Institute, USA (latest edition) with proven design. The condenser shall be designed for heat load corresponding to Valve Wide Open (VWO) conditions, 0% make-up, guaranteed condenser pressure and conditions given in Clause No. 2.02.03. The value of condenser pressure to be measured at 300 mm above the top row of condenser tubes shall be demonstrated under VWO output condition 0% make-up. The condenser vacuum shall be measured with a vacuum grid utilizing ASME basket tips. The grid is fitted at 300 mm above top row of tubes of condenser. Condensate temperature at all loads shall be near to the saturation temperature corresponding to condenser pressure.	**Condenser** (i) Design, manufacturing and testing as per Heat Exchanger Institute, USA (latest edition) with proven design. The condenser shall be designed for heat load corresponding to 105% of TMCR Load ~~Valve Wide Open (VWO) conditions~~, 0% make-up, guaranteed condenser pressure and conditions given in Clause No. 2.02.03. The value of condenser pressure to be measured at 300 mm above the top row of condenser tubes. ~~shall be demonstrated under VWO output condition 0% make-up.~~ The condenser vacuum shall be measured with a vacuum grid utilizing ASME basket tips. The grid is fitted at 300 mm above top row of tubes of condenser. Condensate temperature at all loads shall be near to the saturation temperature corresponding to condenser pressure.

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S. No.	SPECIFICATION REFERENCE				Instead of	Read as
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TG1-04	VI/B	A-07	11.05.00	21 of 25	Adequate maintenance facilities shall be provided as required for assembly, disassembly, …… hydrogen coolers, air cooled condenser system, vacuum pumps, condensate extraction pumps and boiler feed pump cartridges, ……. to be carried out during major overhauls.	Adequate maintenance facilities shall be provided as required for assembly, disassembly, …… hydrogen coolers, **water** cooled condenser system, vacuum pumps, condensate extraction pumps and boiler feed pump cartridges, ……. to be carried out during major overhauls.
TG1-05	VI/A	IIA-06	10.02.00	8 of 10	**EOT CRANE FOR BOILER FEED PUMP** ……. The main hook capacity of each crane shall be 10% over and above the heaviest component/equipment to be handled (including lifting beam, if applicable, and slings etc.) or 25 Tonne whichever is higher. …….	**EOT CRANE FOR BOILER FEED PUMP** ……. The main hook capacity of each crane shall be 10% over and above the heaviest component/equipment **(including Drive Turbine assembly)** to be handled (including lifting beam, if applicable, and slings etc.) or 25 Tonne whichever is higher. …….
TG1-06	VI/B	A-07	7.02.01	19 of 25	One (1) no of Electrically operated travelling cranes …….. The capacity of each crane shall be 10% over and above the heaviest component/equipment to be handled (including lifting beam and slings etc., if provided) or 25 Tonne whichever is higher.	One (1) no of Electrically operated travelling cranes …… The capacity of each crane shall be 10% over and above the heaviest component/equipment **(including Drive Turbine assembly)** to be handled (including lifting beam and slings etc., if provided) or 25 Tonne whichever is higher.
TG1-07	VI/B	G-05	1.01.00	1 of 38	1. NPSH (R) Test on one BFP and one BP 2. Pressure pulsation test on one BFP. 3. Axial thrust measurement on one BFP. 4. Visual cavitation test on one BFP.	1. NPSH (R) Test on one BFP and one BP 2. Pressure pulsation test on one BFP. 3. Axial thrust measurement on one BFP. ~~4. Visual cavitation test on one BFP.~~ 4. Complete strip down test of BFP which undergone above tests.

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
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					5. Complete strip down test of BFP which undergone above tests.	
	VI/B	G-05	1.06.00	3 of 38	**Visual Cavitation test:** Visual cavitation test for one first stage production impeller…… be repeated with 25%, 50%, 65%, 80%, 100% & 125% of Design Point. **Acceptance Criteria:** Cavitation-free (bubble free) at…….. length shall be less than 1% of impeller OD.	Deleted
	VI/B	G-05	**Log sheet for Visual Cavitation (Annexure-IV)**	5 of 38	**Log sheet for Visual Cavitation (Annexure-IV)**	Deleted
TG1-08	VI/B	A-24	1.02.05	2 of 6	……The machine room will be provided with R.C.C. floor slab with necessary pockets for anchor bolts and slots.	…… The machine room will be provided with necessary pockets for anchor bolts and slots. Floor of machine room shall be as specified in the chapter "D-1-5 SALIENT FEATURES & DESIGN CONCEPT" of the specification.

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S. No.	SPECIFICATION REFERENCE				Instead of	Read as
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TG1-09	VI/B	A-07	1.19.00	7 of 25	Furnish thermal kit data for plant performance by DDCMIS and true copies of Performance Guarantee test reports for sets rated for 800 MW or above. Furnish turbine clearance …… leakage rate from glands.	Furnish thermal kit data for plant performance by DDCMIS ~~and true copies of Performance Guarantee test reports for sets rated for 800 MW or above~~. Furnish turbine clearance …… leakage rate from glands.
TG1-10	VI/A	VI/ Chaptor-02	Group B: Mandatory Spares I. TG Items (28)	5 of 31	Spray water injection valve for HP Bypass system complete assembly including actuator, yoke and its control.	Spray water injection valve for HP Bypass system complete assembly including actuator, yoke and its control. **(If valve type is different for control and stop functions then spares to be supplied for both types).**
TG1-11	VI/A	VI/ Chaptor-02	Group C: Mandatory Spares 1. Main Turbine (vi)	10 of 31	LP outer & inner casing fasteners & fixing materials 1set (100 % of each type & size) (Requirement for one Unit)	LP outer & inner casing fasteners & fixing materials (In case of identical item for both LP Turbine, one set for one LP Turbine to be provided). 1set (100 % of each type & size) ~~(Requirement for one Unit)~~
TG1-12	VI/A	VI/ Chaptor-02	4.00.00 A. EHC System related instrumentation (4)	23 of 31	High pressure hoses for HPBP, High Pressure LPBP etc.	Hoses for HP and LP Bypass system.
TG1-13	VI/A	VI/ Chaptor-02	General Note	31 of 31	----------	11. Wherever servomotor is mentioned, it means servomotor/complete actuator along with yoke & its control.
TG1-14	VI/B	A-07	1.16.00 (k)	5 of 25	Bidder shall ensure the requirement of minimum degree of superheat upstream of HPLP bypass valve to avoid wet steam	~~Bidder shall ensure the requirement of minimum degree of superheat upstream of HPLP bypass valve to avoid wet steam entry during start-up cases. However, HP-LP~~

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Section / Part	Sub-Section	Clause No.	Page No.		
					entry during start-up cases. However, HP-LP bypass valve internals/trim shall also be designed to withstand wet steam entry during cold start-up case. Suitable drain lines and drain pot arrangement upstream of HP bypass valve shall also be envisaged to meet above requirement.	~~bypass valve internals/trim shall also be designed to withstand wet steam entry during cold start-up case.~~ ~~Suitable drain lines and drain pot arrangement upstream of HP bypass valve shall also be envisaged to meet above requirement.~~ HP Bypass valves shall be designed as per degree of superheat based on Boiler-Turbine combined start-up curve i.e, degree of superheat based on Main steam pressure and Temperature at the time of HP Bypass valve opening during cold start-up. For achieving degree of superheat as per approved combined start-up curve bidder shall make necessary arrangement for combination of drain lines with drain pots at the upstream of HP Bypass valves. Bidder shall provide necessary pressure and temperature measuring instruments near to HP Bypass valve for calculation of degree of superheat at upstream.
TG1-15	VI/B	G-06	3.03.04 (i)	7of 14	(i) H.P./L.P. Bypass Capabilities (a)…… …….. (c)…… Under all these conditions…… ….. and accepted by the EMPLOYER. The same shall be demonstrated.	New Paragraph added (i) H.P./L.P. Bypass Capabilities (a)…… …….. (c)…… Under all these conditions…….. and accepted by the EMPLOYER. The same shall be demonstrated.

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Section / Part	Sub-Section	Clause No.	Page No.		
						Bidder shall demonstrate the degree of superheat at upstream of HP Bypass valve during cold start-up as per approved Boiler Turbine combined start-up curve (The degree of superheat at upstream of HP bypass valve as derived from boiler turbine startup curve will be specified by bidder in HPBP sizing document). In case the degree of superheat is not achieved as per approved combined start-up curve and subsequently valve starts passing within defect liability period, Bidder shall reassess valve operating condition based on actual steam parameters during cold start-up. Accordingly necessary improvement shall be done by the contractor to prevent further passing in the HP Bypass valves.
TG1-16	VI/B	A-07	11.02.00	21 of 25	The steam turbine generator unit and its auxiliaries …… thermal stresses. Complete technical data including criteria for thermal stresses, cyclic loading, thermal fatigue, together with values of thermal stresses at critical locations shall be furnished to establish the suitability of design for cyclic and two shift operation.	The steam turbine generator unit and its auxiliaries …… thermal stresses. ~~Complete technical data including criteria for thermal stresses, cyclic loading, thermal fatigue, together with values of thermal stresses at critical locations shall be furnished to establish the suitability of design for cyclic and two shift operation.~~
TG1-17	Part-E		XXXX-999-POM-A-006		Auxiliary Steam P&ID	Revised Auxiliary Steam P&ID
TG1-18	VI/B	A-07	5.01.00	11 of 25	**Low Pressure Heaters and Drain Cooler**	**Low Pressure Heaters and Drain Cooler**

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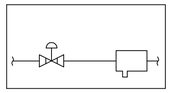
					Horizontal and U-tube type with……be cold bent for fabrication.	Horizontal and U-tube type with……be cold bent for fabrication. Requirement of drain cooler for heaters, installed in condenser neck and heater with drip pump for forward cascading of drains shall be as per standard practice of the bidder and cycle optimisation. If separate drain cooler is offered it shall be of straight or U-tube type.

HCPRDS WITH SEPARATE DESUPERHEATER

BOX–A



BOX–B

SPRAY WATER LINE FROM BFP DISCHARGE/BFP INTERMEDIATE STAGE

SPRAY STATION FOR HCPRDS (REFER NOTE–4)

SPRAY WATER LINE FROM CEP DISCHARGE

TO HCPRDS DESUPERHEATER

SPRAY STATION FOR HCPRDS (REFER NOTE–4)

REFER NOTE 3

FROM MAIN STEAM LINE

FROM COLD REHEAT LINE

COMBINED HCPRDS

DRAIN TO SG FLASH TANK

TO ATM FT

BOP C&I

TG C&I

SG C&I

TYP.

AUX. STEAM UNIT HEADER UNIT #1 (NOTE–10)

TO ATM FT

SPARE CONNECTION

FOR MILL FIRE FIGHTING (IF REQUIRED)

FOR SCR SOOT BLOWING

FOR A.H. SOOT BLOWING

BOILER ACID CLEANING

SCAPH

TO TURBINE GLAND SEALS

TO BFP TURBINE GLANDS.

TO ATM FT

FOR DEAERATOR PEGGING

TO BOILER FEED PUMP TURBINE & HPT WARM UP (STARTUP SOURCE) (SEE NOTE 9)

FOR TURBINE WET STEAM WASHING

SPARE CONNECTION

AUX. STEAM STATION HEADER UNIT #1 (NOTE–10)

FOR FUTURE INTERCONNECTION

SPARE CONNECTION

FOR AMMONIA/UREA FOR De–NOx SYSTEM

SPARE FOR FGD SYSTEM

TO ATM FT

SPARE CONNECTION

TAP OFF FOR FUTURE INTER CONNECTION

(Near at Stage–II)

(At mid of Connecting Header)

(Near at Stage–I)

NTPC

High Temperature Aux. Steam Station header (Stage–I)

VENDOR

(Near at Stage–II)

(TYP.)

(To Boiler Drain Flash Tank of Stage–II)

FROM AUX. STEAM HEADER OF OTHER UNIT

NOTES

1. ALL DRAINS SHALL BE LED TO THE ATMOSPHERIC FLASH TANK SHOWN IN DRG: STEAM DRAIN SYSTEM P&ID.
2. DRAINS AND VENTS SHOWN IN THIS DRAWING ARE INDICATIVE ONLY. FINAL REQUIREMENT SHALL BE FINALISED BASED ON PROCESS & LAYOUT CONSIDERATIONS.
3. THE BIDDER MAY PROVIDE COMBINED PRESSURE REDUCING CUM DESUPERHEATING VALVE OR PRESSURE REDUCING VALVE WITH A SEPARATE DESUPERHEATER AS SHOWN IN BOX–A.
4. DESUPERHEATING WATER SPRAY FOR HCPRDS IS SHOWN FROM BFP DISCHARGE INTERMEDIATE STAGE. THE SAME CAN BE CHANGED TO ANY OTHER APPROPRIATE LOCATION, INCASE, BIDDER OPTS FOR SPRAY FOR HCPRDS FROM CEP DISCHARGE, THE SPRAY STATION SHALL BE REPLACED BY THE ONE SHOWN IN BOX–B
5. AT ALL EQUIPMENT/VALVES/SPECIALITIES TO PIPING INTERFACE POINT MATCHING COUNTER FLANGES,WHEREVER REQUIRED, SHALL BE SUPPLIED BY THE EQUIPMENT/VALVES/SPECIALITIES SUPPLIER.
6. BIDDER SHALL PROVIDE STUBS AND TAPPINGS FOR PG TEST OF EQUIPMENTS/SYSTEM UNDER HIS SCOPE OF SUPPLY AND FOR SAMPLING WHEREVER REQUIRED.
7. NO. OF SAFETY VALVES SHOWN ON PIPINGS IS INDICATIVE ONLY. THIS SHALL BE AS PER SPECIFICATIONS/MANUFACTURERS STANDARD PRACTICE.
8. VENTURI TYPE OF FLOW ELEMENT IS SHOWN HERE, HOWEVER ,BIDDER MAY OFFER NOZZLE TYPE OF FLOW ELEMENT BASED ON HIS STANDARD PRATICE OR AS PER THE RANGE OF REYNOLDS NO AS MENTIONED IN ISO–5167.
9. THE COMPLETE SYSTEM, INCLUDING COMMON HEADER WITH INTERCONNECTIONS WITH EACH UNIT SHALL BE IN THE SCOPE OF VENDOR AND THE SYSTEM SHALL BE DESIGNED SO AS TO ENABLE STARTUP OF ANY UNIT WITH TDBFP BY TAKING MOTIVE STEAM FROM OTHER RUNNING UNITS.
10. #THE OPERATING PRESSURE AND TEMPERATURE OF AUX. STEAM UNIT STATION HEADER SHALL BE OPTIMIZED BY THE BIDDER MAINTAINING A MINIMUM 50C SUPERHEAT AND MINIMUM TEMPERATURE OF 310°C.
11. ALL THE INSTRUMENTS SHALL BE IN THE SCOPE OF BIDDER.THE MEASURING INSTRUMENTS INDICATED IN THE TENDER P&ID ARE MINIMUM THAT ARE REQUIRED TO BE PROVIDED BY THE BIDDER.IN CASE ADDITIONAL INSTRUMENTS ARE REQUIRED AS PER THE STANDARD & PROVEN PRACTICE OF BIDDER, THE SAME SHALL BE SUPPLIED WITHIN THIS CONTRACT.
12. SG–C&I,TG–C&I AND BOP–C&I PART OF DDCMIS ARE IN THE CONTRACTOR's SCOPE OF SUPPLY.
13. ALL THE REMOTE INSTRUMENTS TO BE HOOKED UP TO THE SG CONTROL SYSTEM (AUX. PRDS CONTROL SYSTEM) UNLESS INDICATED OTHERWISE.

FOR TENDER PURPOSE ONLY

NTPC Ltd.
(A Government of India Enterprise)
ENGINEERING DIVISION

PROJECT: LARA STPP STAGE–II (2X800 MW) (EPC PACKAGE)

TITLE: AUXILIARY STEAM SYSTEM P&ID

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.		APPD.	DATE
A	RELEASED FOR TENDER	AS	AS	PKD	M C&I CLEARED BY	AA	06/06/22

SIZE	SCALE	DRG NO.	REV. NO.
A–1	NTS	XXXX–999–POM–A–006	A

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S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Section / Part	Sub-Section	Clause No.	Page No.		
WS1-01	VI/A	I	1.02.00	3 OF 9	Water Treatment Plant Including, - DM plant and CW chemical treatment. - Pre treatment and liquid effluent treatment plant - Chlorine di-oxide plant - Condensate polishing unit including regeneration facility - Reverse osmosis plant for waste water	Water Treatment Plant Including, - DM plant and CW chemical treatment. - Pre treatment and liquid effluent treatment plant - Chlorine di-oxide plant - Condensate polishing unit including regeneration facility
WS1-02	VI/A	IIA-10	1.01.02.c	2 OF 12	One (1) number filtered water reservoir (in twin sections located below the filters) of RCC Construction, filtered water sump and common filtered water pump house for PT – Potable water & PT-DM systems.	One (1) number filtered water reservoir (in twin sections located below the filters) of RCC Construction, filtered water sump **each for** PT –Potable water & PT-DM systems with **common filtered water pump house.**
WS1-03	VI/A	IIA-20	2.03.00	1 OF 2	Inclusion of adequate resins for all the condensate polisher service vessels, resin storage vessels (2 nos.) in regeneration area and one (1) additional charge for use during commissioning stage of unit. Therefore, total number of charges supplied by bidder shall be either eleven (11) or nine (9) corresponding to offered configuration (4 x 33.33 % or 3 x 50%) of service vessels.	Inclusion of adequate resins for all the condensate polisher service vessels, resin storage vessel in regeneration area and one (1) additional charge for use during commissioning stage of unit. Therefore, total number of charges supplied by bidder shall be **either ten (10) or eight (8)** corresponding to offered configuration (4 x 33.33 % or 3 x 50%) of service vessels.
WS1-04	VI/A	IIA-20	2.04.00 b)	2 OF 2	CPU Regeneration facilities shall consist of but not limited to the following systems and equipments: a) ..... b) One (1) set of regeneration facilities consisting of Resin separation vessel,	CPU Regeneration facilities shall consist of but not limited to the following systems and equipments: a) ..... b) One (1) set of regeneration facilities consisting of Resin separation vessel,

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
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					Cation, Anion regeneration vessel(s), Resin make-up hopper, Mixed resin storage vessels (2 nos) etc.	Cation, Anion regeneration vessel(s), Resin make-up hopper, Mixed resin storage vessels (**1 no**) etc.
WS1-05	VI/A	VI, CHAPTER-1	4.00.00 B	30 OF 38	B Plate Type Heat Exchangers i Gaskets = 1 Lot comprising 30% of total requirement of each type & size ii Fasteners = 1 Lot comprising 10% each type iii Plates = 1 Lot comprising 20% of each type	Clause deleted
WS1-06	VI/A	VI CHAPTER-02	1.00.00	26 OF 31	CPU/Regen Area Blowers ….. 4)Gears	CPU/Regen Area Blowers ….. 4) Gears **(if applicable**)
WS1-07	VI/A	VI CHAPTER-02	1.00.01	26 OF 31	CPU/Regen Area Pumps including N-pit & Backwash ……. 6) Stuffing box for each type ……. Agitators ……. 4) Any other agitator assembly with motor & gear box	CPU/Regen Area Pumps including N-pit & Backwash ……. 6) Stuffing box for each type **(if applicable)** ……. Agitators ……. 4) Any other agitator assembly with motor & gear box **(if applicable)**
WS1-08	VI/A	VI CHAPTER-08	3.00.00	27 OF 28	Blowers 1 Impeller with lock nuts and washers 1 set 2 Air Filters 2 no. 3 Bearings for drive & driven 1 set 4 Oil Seals 1 set 5 Gears 1 set 6 V-belts 1 Set for each drive	Clause deleted

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WS1-09	VI/B	A-01	3.06.00 C.3.a)	64 of 101	One (1) number RCC waste service water sump (WSWS)…….....Facility shall be provided to collect free oil from these sumps to MS Oil drum and oil skimmers (2 nos.), Portable oil Centrifuge (1x100%) of suitable capacity shall be provided for reuse of oil.	One (1) number RCC waste service water sump (WSWS)…….....Facility shall be provided to collect free oil from these sumps to MS Oil drum and oil skimmers (2 nos.), Portable oil Centrifuge **(2x100%)** of suitable capacity shall be provided for reuse of oil.
WS1-10	VI/B	A-01	3.06.00 D 4a)	68 OF 100	Two (2) numbers of DM water storage tanks with all accessories	Two (2) nos D.M. water storage tank (**max dia 16m and min usable capacity of 2450m3) with all accessories to store DM water in Existing DM plant area and interconnection with the existing DM Water tanks through necessary piping, valves and fittings.**
WS1-11	VI/B	A-01	3.06.00 D 2l)	66 OF 100	l) Two (2) numbers of DM water storage tanks (Min. capacity 2450 m3) with all accessories with vent, drain, CO_2 absorber, PVC balls, overflow, and seal pots.	Clause deleted.
WS1-12	VI/B	A-01	3.05.00 k	57 OF 91	k) Air pre-heater wash water pumps Air pre-heater wash water pumps shall draw water from service water tank.	k) Air pre-heater wash water pumps Air pre-heater wash water pumps shall draw water from **clarified water tank.**
WS1-13	VI/B	A-01	3.02.00	57 of 101	c) Quantity of water to be cooled by Cooling Towers of One Unit: CW pumps flow per unit + 10% margin d) Heat Load (Excluding Heat of	c) Quantity of water to be cooled by Cooling Towers of One Unit: CW pumps flow per unit **(+5% margin to be considered in hot water distribution system to avoid overflow)**

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
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					Evaporation): As per system requirement (10% margin to be taken for CW pump flow only, however heat load to be taken as actual)	d) Heat Load (Excluding Heat of Evaporation): **Design range X Design CW pump flow**
WS1-14	VI/B	A-01	3.06.00 C. 4. a)	64 of 101	4. Coal handling plant run-off water treatment system a) Two (2) numbers of Coal Slurry Settling (CSSP) Ponds (minimum size of 40m x 8m x 3m deep) of RCC Construction shall be provided.	4. Coal handling plant run-off water treatment system a) Two (2) numbers of Coal Slurry Settling (CSSP) Ponds (minimum size of 40m x 8m x 3m deep) of RCC Construction shall be provided. **Suitable approach to be provided for mechanical cleaning of CSSP ponds.**
WS1-15	VI/B	A-11	4.06.00	5 OF 16	1)Resin Separation & Cation Regeneration Vessel(2sets). 2) Anion Resin Regeneration Vessel (2 sets). 3) Mixed Resin storage vessel (2 sets).	1)Resin Separation & Cation Regeneration Vessel**(1set).** 2)Anion Resin Regeneration Vessel **(1set).** 3) Mixed Resin storage vessel **(1 set).**
WS1-16	VI/B	A-11	4.05.00 13. c)	5 OF 16	Design temperature of service vessel and their internals/appurtenances shall take care of all operating regimes including HP-LP bypass operation and minimum 700C.Process design temperature shall be based on all operating regimes of TG cycle and minimum 520C. However, short term excursion of temperature upto 600C is also expected.	Design temperature of service vessel and their internals/appurtenances shall take care of all operating regimes including HP-LP bypass operation and minimum **70degC**.Process design temperature shall be based on all operating regimes of TG cycle and minimum **52deg C**. However, short term excursion of temperature upto **60 degC** is also expected.

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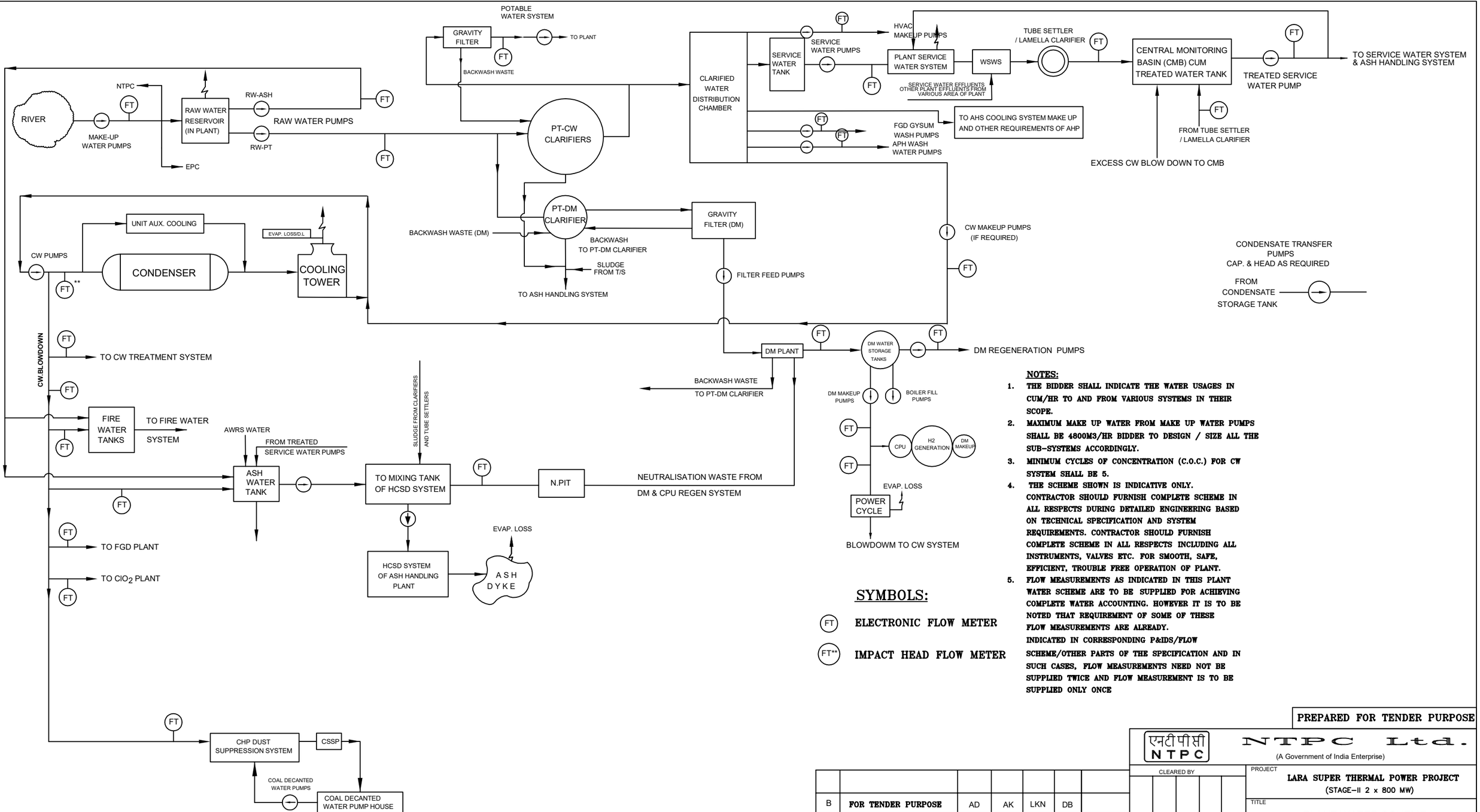
WS1-17	VI/B	A-14	1.01.00 4) c)		New clause added	Excess AWRS water, if any after use in Ash Handling System, shall be suitably treated for recycle and re-use in Service water/ CHP dust suppression etc. to ensure ZLD.
WS1-18	VI/B	G-04		98 OF 217	PG Test Procedure for TG & SG Plate Heat Exchanger (PHE)	Deleted.
WS1-19	VI/E	-	Sl No.49	-	Plant water Scheme, tender drg no. 9587-999-POM-A-037 REV.A	Plant water Scheme, tender drg no. 9587-999-POM-A-037 REV.B
WS1-20	VI/E	-	Sl No.68	-	P & ID Pre-treatment Plant , tender drg no. 9587-999-POM-A-006 REV.A	P & ID Pre-treatment Plant, tender drg no. 9587-999-POM-A-006 REV.B
WS1-21	VI/B	A-15	3.3.00	11 OF 43	Number of operating cells in the cooling tower shall not be less than eight (8). Bidder shall provide spare cells (Minimum four (4) per tower) in the cooling tower to facilitate maintenance without affecting the tower performance.	Bidder shall provide spare cells (Minimum four (4) per tower) in the cooling tower to facilitate maintenance without affecting the tower performance.
WS1-22	VI/B	A-01	3.06.00 C. 4. d)	64 of 101	Two (2) numbers (2x100%) Coal Decanted Water Pumps for reuse of coal decanted water in CHP dust suppression system.	Two (2) numbers (2x100%) Coal Decanted Water Pumps for reuse of coal decanted water in CHP dust suppression system. **(Plain Water Dust Suppression system)**



SYMBOLS:

- (FT) ELECTRONIC FLOW METER
- (FT**) IMPACT HEAD FLOW METER

NOTES:

1. THE BIDDER SHALL INDICATE THE WATER USAGES IN CUM/HR TO AND FROM VARIOUS SYSTEMS IN THEIR SCOPE.
2. MAXIMUM MAKE UP WATER FROM MAKE UP WATER PUMPS SHALL BE 4800M3/HR BIDDER TO DESIGN / SIZE ALL THE SUB-SYSTEMS ACCORDINGLY.
3. MINIMUM CYCLES OF CONCENTRATION (C.O.C.) FOR CW SYSTEM SHALL BE 5.
4. THE SCHEME SHOWN IS INDICATIVE ONLY. CONTRACTOR SHOULD FURNISH COMPLETE SCHEME IN ALL RESPECTS DURING DETAILED ENGINEERING BASED ON TECHNICAL SPECIFICATION AND SYSTEM REQUIREMENTS. CONTRACTOR SHOULD FURNISH COMPLETE SCHEME IN ALL RESPECTS INCLUDING ALL INSTRUMENTS, VALVES ETC. FOR SMOOTH, SAFE, EFFICIENT, TROUBLE FREE OPERATION OF PLANT.
5. FLOW MEASUREMENTS AS INDICATED IN THIS PLANT WATER SCHEME ARE TO BE SUPPLIED FOR ACHIEVING COMPLETE WATER ACCOUNTING. HOWEVER IT IS TO BE NOTED THAT REQUIREMENT OF SOME OF THESE FLOW MEASUREMENTS ARE ALREADY INDICATED IN CORRESPONDING P&IDS/FLOW SCHEME/OTHER PARTS OF THE SPECIFICATION AND IN SUCH CASES, FLOW MEASUREMENTS NEED NOT BE SUPPLIED TWICE AND FLOW MEASUREMENT IS TO BE SUPPLIED ONLY ONCE

PREPARED FOR TENDER PURPOSE

REV.NO	DESCRIPTION	DRAWN/ DESIGN	REVIEWED BY		APPRVD BY	
B	FOR TENDER PURPOSE	AD	AK	LKN	DB	
		WS	WS	WS	WS	

CLEARED BY

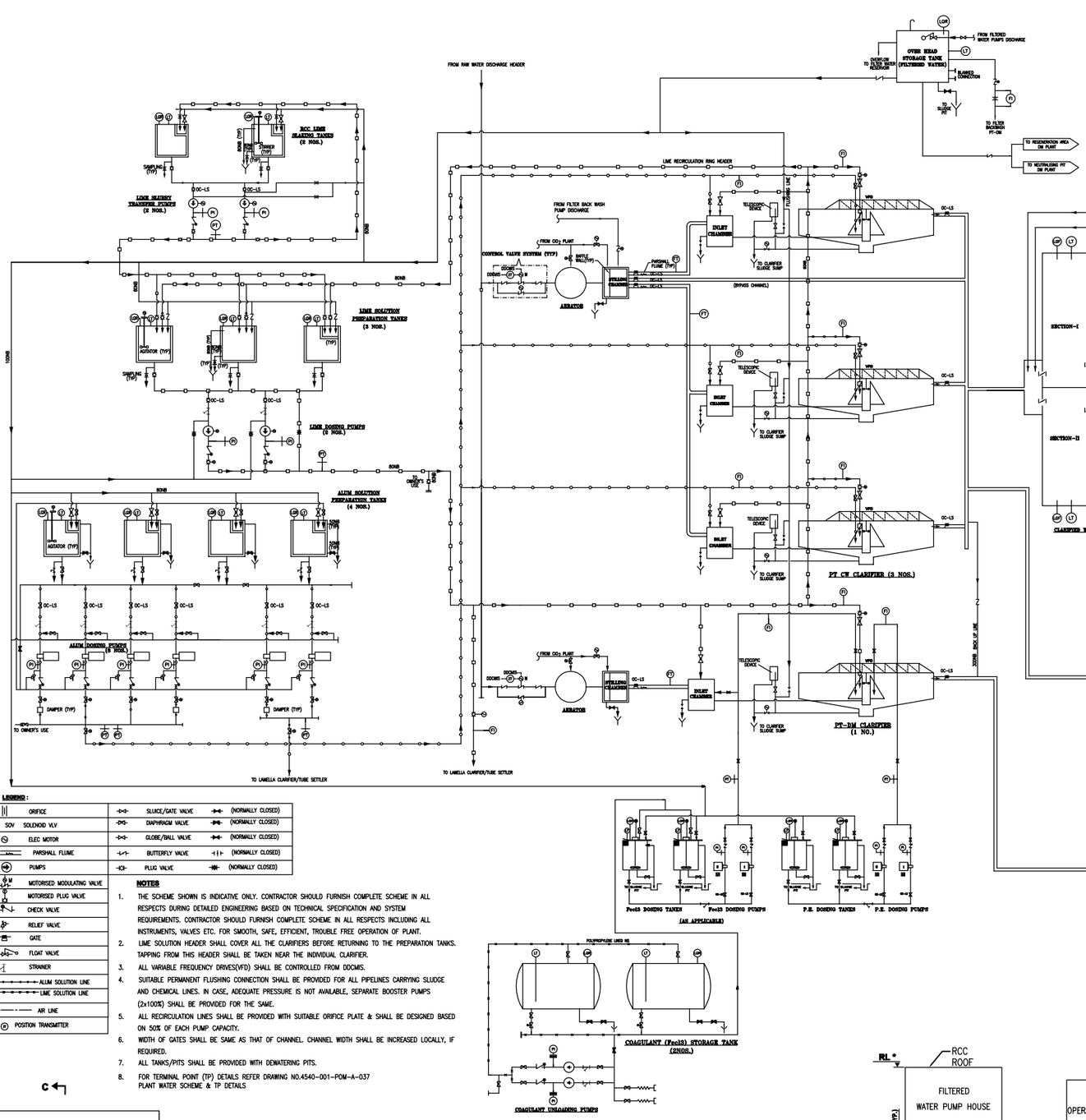
DRN	DGN	CHKD	APPD	DATE
				27.12.22

एनटीपीसी NTPC — NTPC Ltd. (A Government of India Enterprise)

PROJECT: LARA SUPER THERMAL POWER PROJECT (STAGE-II 2 x 800 MW)

TITLE: PLANT WATER SCHEME

SCALE | DRG NO. 9587-999-POM-A-037 | REV B



LEGEND :

ORIFICE	SLUICE/GATE VALVE		(NORMALLY CLOSED)
SOV SOLENOID VLV	DIAPHRAGM VALVE		(NORMALLY CLOSED)
ELEC MOTOR	GLOBE/BALL VALVE		(NORMALLY CLOSED)
PARSHALL FLUME	BUTTERFLY VALVE		(NORMALLY CLOSED)
PUMPS	PLUG VALVE		(NORMALLY CLOSED)
MOTORISED MODULATING VALVE			
MOTORISED PLUG VALVE			
CHECK VALVE			
RELIEF VALVE			
GATE			
FLOAT VALVE			
STRAINER			
ALUM SOLUTION LINE			
LIME SOLUTION LINE			
AIR LINE			
POSITION TRANSMITTER			

NOTES

1. THE SCHEME SHOWN IS INDICATIVE ONLY. CONTRACTOR SHOULD FURNISH COMPLETE SCHEME IN ALL RESPECTS DURING DETAILED ENGINEERING BASED ON TECHNICAL SPECIFICATION AND SYSTEM REQUIREMENTS. CONTRACTOR SHOULD FURNISH COMPLETE SCHEME IN ALL RESPECTS INCLUDING ALL INSTRUMENTS, VALVES ETC. FOR SMOOTH, SAFE, EFFICIENT, TROUBLE FREE OPERATION OF PLANT.
2. LIME SOLUTION HEADER SHALL COVER ALL THE CLARIFIERS BEFORE RETURNING TO THE PREPARATION TANKS. TAPPING FROM THIS HEADER SHALL BE TAKEN NEAR THE INDIVIDUAL CLARIFIER.
3. ALL VARIABLE FREQUENCY DRIVES(VFD) SHALL BE CONTROLLED FROM DDCMIS.
4. SUITABLE PERMANENT FLUSHING CONNECTION SHALL BE PROVIDED FOR ALL PIPELINES CARRYING SLUDGE AND CHEMICAL LINES. IN CASE, ADEQUATE PRESSURE IS NOT AVAILABLE, SEPARATE BOOSTER PUMPS (2x100%) SHALL BE PROVIDED FOR THE SAME.
5. ALL RECIRCULATION LINES SHALL BE PROVIDED WITH SUITABLE ORIFICE PLATE & SHALL BE DESIGNED BASED ON 50% OF EACH PUMP CAPACITY.
6. WIDTH OF GATES SHALL BE SAME AS THAT OF CHANNEL. CHANNEL WIDTH SHALL BE INCREASED LOCALLY, IF REQUIRED.
7. ALL TANKS/PITS SHALL BE PROVIDED WITH DEWATERING PITS.
8. FOR TERMINAL POINT (TP) DETAILS REFER DRAWING NO.4540-001-POM-A-037 PLANT WATER SCHEME & TP DETAILS

c

DM GRAVITY FILTERS
PIPING GALLERY
SUMP CUM PUMP HOUSE, BLOWERS & MAINTENANCE SPACE

c

GRAVITY FILTER
BOTH FOR OPTION 1 & 2

FOR TENDER PURPOSE ONLY

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	C	LAYOUT(M)	M	E	C&I	APPD	DATE
A	RELEASED FOR TENDER	TARUN			CLEARED BY						

NTPC Limited
(A GOVT. OF INDIA INTERPRISE)
ENGINEERING DIVISION

PROJECT: LARA SUPER THERMAL POWER PROJECT
STAGE-II (2 X 800MW)

TITLE: SINGLE LINE FLOW & INSTRUMENTATION DIAGRAM OF PRE-TREATMENT PLANT

SIZE	SCALE	DRG.NO.	REV.
A1	NTS	9587-999-POM-A-006	B

CAD FILE NAME : 9587-999-POM-A-006

EPC PACKAGE FOR LARA SUPER THERMAL POWER PROJECT, STAGE-II (2x800 MW)
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<table>
<tr><th rowspan="2">S. No.</th><th colspan="4">SPECIFICATION REFERENCE</th><th rowspan="2">Instead of</th><th rowspan="2">Read as</th></tr>
<tr><th>Section / Part</th><th>Sub-Section</th><th>Clause No.</th><th>Page No.</th></tr>
<tr><td>PIP1-01</td><td>VI PART-A</td><td>SUB SECTION VI

MANDATORY SPARES

CHAPTER 6 PIPING</td><td>2.0 POWER CYCLE PIPING</td><td>PG NO. 1 OF 3</td><td><table><tr><td>5)</td><td>Spare gaskets/pressure seal gaskets for NRV of all sizes</td><td>50% population of each type, material, size & class of one unit</td></tr><tr><td>6)</td><td>Spare set of gaskets for safety valves, relief valves and safety relief valves of all sizes</td><td>50% population of each type, material, size & class of one unit</td></tr></table></td><td><table><tr><td>5)</td><td>Spare gaskets/pressure seal gaskets for NRV of all sizes
(if applicable)</td><td>50% population of each type, material, size & class of one unit</td></tr><tr><td>6)</td><td>Spare set of gaskets for safety valves, relief valves and safety relief valves of all sizes
(if applicable)</td><td>50% population of each type, material, size & class of one unit</td></tr></table></td></tr>
<tr><td>PIP1-02</td><td>VI PART-A</td><td>SUB SECTION VI

MANDATORY SPARES

CHAPTER 6 PIPING</td><td>2.0 POWER CYCLE PIPING</td><td>PG NO. 1 OF 3</td><td><table><tr><td>9)</td><td>Complete angle valves assembly up to the inlet size of 50 NB</td><td>50% population of each type, material, size & class of one unit.</td></tr></table></td><td><table><tr><td>9)</td><td>Complete angle valves assembly up to the inlet size of 50 NB
(if applicable)</td><td>50% population of each type, material, size & class of one unit.</td></tr></table></td></tr>
</table>

EPC PACKAGE FOR LARA SUPER THERMAL POWER PROJECT, STAGE-II (2x800 MW)
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PIP1-03	VI PART-A	SUB SECTION VI MANDATORY SPARES CHAPTER 6 PIPING	2.0 POWER CYCLE PIPING	PG NO. 2 OF 3	13) Gasket for each flanged connection on high pressure steam and feed line. — 3 Nos. per unit	13) Gasket for each flanged connection on high pressure steam and feed line. (if applicable) — 3 Nos. per unit
PIP1-04	VI PART-A	SUB SECTION VI MANDATORY SPARES CHAPTER 6 PIPING	2.0 POWER CYCLE PIPING	PG NO. 2 OF 3	14a) safety valves, relief valves and safety relief valves up to 50 NB size — 02 nos. of each type, material, size & class per unit	14a) safety valves, relief valves and safety relief valves up to 50 NB size (if applicable) — 02 nos. of each type, material, size & class per unit. (If there is one no. valve only of particular type, class, and size then only one no per unit to be considered.)
PIP1-05	VI PART-A	SUB SECTION VI MANDATORY SPARES CHAPTER 6 PIPING	2.0 POWER CYCLE PIPING	PG NO. 2 OF 3	15b) Steam trap & Y strainer above 25 NB & up to 50 NB — 05 nos. of each type, material, size & class per unit	15b) safety valves, relief valves and safety relief valves up to 50 NB size (if applicable) — 02 nos. of each type, material, size & class per unit

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					15c) Steam trap & Y strainer above 50 NB — 02 nos. of each type, material, size & class per unit	15c) Steam trap & Y strainer above 50 NB (if applicable) — 02 nos. of each type, material, size & class per unit
PIP1-06	VI PART-A	SUB SECTION VI MANDATORY SPARES CHAPTER 6 PIPING	2.0 POWER CYCLE PIPING	PG NO. 3 OF 3	16) Complete Valve assembly (all types) for sizes above 50 NB and up to & including 250 NB — 02 nos. of each type, material, size & class per unit	16) Complete Valve assembly (all types) for sizes above 50 NB and up to & including 250 NB — 02 nos. of each type, material, size & class per unit..(If there is one no. valve only of particular type, class, and size then, only one no per unit to be considered.)
PIP1-07	VI PART-A	SUB SECTION VI MANDATORY SPARES CHAPTER 6 PIPING	2.0 POWER CYCLE PIPING	PG NO. 3 OF 3	Notes: 1) Mandatory spare requirements of Valves and specialties for power cycle piping systems (Sub Section: A-07 of Part-A of Technical Specifications) specified above does not include items/valves/specialties which are already specified/ covered elsewhere in this Technical specification for mandatory spare requirement.	Notes: 1) Mandatory spare requirements of Valves and specialties for power cycle piping systems (Sub Section: A-07 of Part-A of Technical Specifications) specified above does not include items/valves/specialties which are already specified/ covered elsewhere in this Technical specification for mandatory spare requirement.

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					2) Wherever complete valve assembly as mandatory spare has been specified above for power cycle piping, it shall include complete gear operator/ box assembly which forms part of original valve assembly/supply. 3) Mandatory spares for valve actuators (for Pneumatically, Hydraulically & Electrically operated valves) shall be supplied as per actuator quantity/details specified elsewhere in this technical specification for mandatory spare requirement. 4) Mandatory spare requirement for complete valve assembly above 50NB in power cycle piping systems shall include Gate valve, Globe valve, check valve, safety valve, Angle valve, butterfly valve etc. 5) In case the quantity of mandatory spares so calculated happens to be a fraction, the same shall be rounded off to next higher whole number. For example, 10% of 11 is equal to 1.1, then it should be rounded as 2 instead of 1. 6) Mandatory spares for valves above 50NB made of A105 / A216 WCC installed on 15NiCuMoNb5 (EN 1.6368) / ASTM A335 Grade P36 piping shall be supplied with suitable matching pieces (in welded condition with valve ends at valve manufacturing works).	2) Wherever complete valve assembly as mandatory spare has been specified above for power cycle piping, it shall include complete gear operator/ box assembly which forms part of original valve assembly/supply. 3) Mandatory spares for valve actuators (for Pneumatically, Hydraulically & Electrically operated valves) shall be supplied as per actuator quantity/details specified elsewhere in this technical specification for mandatory spare requirement. 4) Mandatory spare requirement for complete valve assembly above 50NB in power cycle piping systems shall include Gate valve, Globe valve, check valve, safety valve, Angle valve, butterfly valve etc. 5) In case the quantity of mandatory spares so calculated happens to be a fraction, the same shall be rounded off to next higher whole number. For example, 10% of 11 is equal to 1.1, then it should be rounded as 2 instead of 1. 6) Mandatory spares for valves above 50NB made of A105 / A216 WCC installed on 15NiCuMoNb5 (EN 1.6368) / ASTM A335 Grade P36 piping shall be supplied with suitable matching pieces (in welded condition with valve ends at valve manufacturing works).

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					7) Wherever Mandatory spares are specified as "per unit", Total Mandatory spares quantity shall be arrived by multiplying the specified quantity with number of units under the package. 8) In case any of the above specified mandatory spares / Items are not covered in the actual design / supply, then that spares / items may be treated as "not applicable".	7) Wherever Mandatory spares are specified as "per unit", Total Mandatory spares quantity shall be arrived by multiplying the specified quantity with number of units under the package. 8) Deleted
PIP1-08	**VI PART-A**	**SUB SECTION III TERMINAL POINTS & EXCLUSIONS**	**CLAUSE 1.01.01**	**PG NO.1 OF 3**	Auxiliary Steam System Headers Interconnection a) TP for Auxiliary Steam interconnection for Auxiliary Steam Station Header with existing Stage-I with motorized isolation valve as indicated in the tender drg. b) The stub/Tee-off connections with Isolating valve and blank flange on the auxiliary steam Unit/Station header for future connections as indicated in the tender drg. All the interconnection with existing piping system to be done by the bidder. All the valves and fittings required for interconnection shall be provided by bidder.	Auxiliary Steam System Headers Interconnection a) TP Location for Auxiliary Steam interconnection for Auxiliary Steam Station Header with existing Stage-I with motorized isolation valve as indicated in the tender drg. Shall be near Column No. 2, C-Row at 35 M elevation of Stage I TG Bay. b) The stub/Tee-off connections with Isolating valve and blank flange on the auxiliary steam Unit/Station header for future connections as indicated in the tender drg. All the interconnection with existing piping system to be done by the bidder. All the valves and fittings, Anchors / Additional Supports required for interconnection shall be provided by the bidder.

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PIP1-09	VI PART-B	SUB SECTION A-09 LOW PRESSURE PIPING	1.05.00	PG NO. 2 OF 20	Based on the inside diameter so established, minimum thickness calculation shall be made as per ANSI B 31.1 OD. Manufacturing allowance shall be added to minimum calculated thickness and next higher standard thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B36.19 as the case may be. Selected thickness then shall be checked for vacuum loading criterion as per the guidelines given in AWWA-M-11, as applicable for the systems.	Based on the inside diameter so established, minimum thickness calculation shall be made as per ANSI B 31.1 OD. Manufacturing allowance shall be added to minimum calculated thickness and next higher standard thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B36.19 as the case may be. Alternatively, manufacturers standard thickness can also be accepted subject to that such thickness shall be equal to or more than the minimum calculated thickness after considering manufacturing allowance. Selected thickness then shall be checked for vacuum loading criterion as per the guidelines given in AWWA-M-11. However, in no case, the selected Thickness for various pipe sizes shall be less than the following for indicated Pipe Sizes as below: 200 NB - 6mm 250 NB – 6 mm 300 NB - 6 mm 350 NB- 6mm 400 NB- 6 mm 450 NB- 6 mm 500 NB- 6 mm 600 NB- 6mm 700 NB- 7mm 800 NB- 8 mm 900 Nb – 10 mm 1000 Nb – 10 mm 1100 Nb – 10mm 1200 Nb – 12 mm

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LAY1-01	VI/B	G-03	1.08.00	14 of 14	Bottom flange level of Air-Preheaters (Both Primary and Secondary) hoppers and additional hoppers (if any) shall be fixed based on dry ash evacuation system as offered by the bidder taking care of clear height requirement between Boiler & ESP and considering unobstructed route for Fly Ash conveying pipes avoiding vertical bends.	Bottom flange level of Air-Preheaters (Both Primary and Secondary) hoppers and additional hoppers (if any) shall be fixed based on ash evacuation system as offered by the bidder taking care of clear height requirement between Boiler & ESP and considering unobstructed route for Fly Ash conveying pipes avoiding vertical bends.
LAY1-02	VI/B	G-03	1.04.00(5)	13 of 14	1. The Bidder shall also make arrangement for storing following mandatory spares (whichever is applicable as per scope of the package) inside TG hall with access from EOT crane: a. Complete assembly of HPT module or its alternative, as applicable b. Complete assembly of IPT module or its alternative, as applicable c. LP Turbine bladed rotor assembly d. HP/IP/LP casing e. Drive Turbine bladed rotor for TDBFP f. Generator stator / Rotor g. Boiler Feed Pump motor	1. The Bidder shall also make arrangement for storing following mandatory spares (whichever is applicable as per scope of the package) inside TG hall with access from EOT crane: a. Complete assembly of HPT module or its alternative, as applicable b. Complete assembly of IPT module or its alternative, as applicable c. LP Turbine bladed rotor assembly d. HP/IP/LP casing e. Drive Turbine bladed rotor for TDBFP f. Generator Rotor g. Boiler Feed Pump motor

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LAY1-03	VI/B	G-03	1.03.00(39)(IV)	10 of 14	Fire water pipes in main plant area shall generally be routed either on trestle or shall be supported from main plant structure, except in transformer yard area and in C-D bay, where the FW pipes shall be routed in trenches. Further, fire water pipes shall be routed underground (with proper encasement of pipes at roads/passage bay crossings) by the sides of main plant roads (inside the main plant area) from transformer yard to chimney area after clearing the road side drains. Fire water pipes shall not be routed on the same trestle over which the fuel oil pipes and steam pipes are running. In offsite areas, fire water pipes can be routed on trestles or on pedestals. In exceptional cases, fire pipes can be buried.	Fire water pipes in main plant area shall generally be routed either on trestle or shall be supported from main plant structure, except in transformer yard area and in C-D bay, where the FW pipes shall be routed in trenches. In case of front/ rear mill arrangement, from D row to last row of boiler column pipe shall either be routed on separate structure or within trench. However, in case of trench heavy duty cover to be provided throughout the length of trench. Further, fire water pipes shall be routed underground (with proper encasement of pipes at roads/passage bay crossings) by the sides of main plant roads (inside the main plant area) from transformer yard to chimney area after clearing the road side drains. Fire water pipes shall not be routed on the same trestle over which the fuel oil pipes and steam pipes are running. In offsite areas, fire water pipes can be routed on trestles or on pedestals. In exceptional cases, fire pipes can be buried.
LAY1-04	VI / PART-C	General Technical requirements	8.03.04	15 of 106	Contractor shall prepare the model of all the facilities located within plant boundary covering facilities in Main Plant Block area and Balance of plant (BOP) area in an integrated & intelligent 3D software solution. Main Plant Block area shall include ACC,	Contractor shall prepare the model of all the facilities located within plant boundary covering facilities in Main Plant Block area and Balance of plant (BOP) area in an integrated & intelligent 3D software solution. Main Plant Block area shall include ACC, Transformer Yard, TG building (including all facilities), Boiler area, ESP area,

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					Transformer Yard, TG building (including all facilities), Boiler area, ESP area, chimney area, FGD area and any other facility located in main plant block. BOP area shall include all facilities pertaining to AHP, CHP, LHP, GHP, DM PT plant, pipe & cable racks and any other facility located within plant boundary. All piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings of major buildings and structural arrangement drawings and RCC layout drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings. Contractor shall prepare and provide 3D design review model (network ready, which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc.), which is extracted from intelligent 3D model and shall make a presentation of the same every 3 months from LOA to enable NTPC to review the progress of engineering or as & when required by employer .	chimney area, FGD area and any other facility located in main plant block. BOP area shall include all facilities pertaining to AHP, CHP, LHP, GHP, DM PT plant, pipe & cable racks and any other facility located within plant boundary. All piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings of major buildings and structural arrangement drawings and RCC layout drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings. Contractor shall prepare and provide 3D design review model (network ready, which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc.), which is extracted from intelligent 3D model and shall make a presentation of the same every 3 months from LOA to enable NTPC to review the progress of engineering or as & when required by employer. Observations of NTPC during the 3D model review to be incorporated and revised editable model to be submitted to NTPC within 2 weeks. The complete 3D data(editable model) which shall be utilised for all future detailed engineering related to maintenance, operation , R&M , efficiency improvement

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					The complete 3D data(editable model) which shall be utilised for all future detailed engineering related to maintenance, operation , R&M , efficiency improvement of the project etc .Complete 3D model along with as built GADs , layout , isometrics , reports extracted and 3D models for all disciplines , with any other document generated from 3D model and naming conventions with as-built updates along with complete reference databases, component catalogues for all the size range shall be handed over to owner. Apart from the 3D Model, all drawings like GADs, Isometrics etc. extracted from the model shall also be submitted by the Contractor in Electronic form. 3D model along with complete Project databases shall be submitted at each model review stage and as final as-built. The contractor shall also submit all the configuration files, customization files, templates and all referenced databases. All input files of software used for design of Equipments / Piping like CAESAR2 files, input files for Pressure vessel design, datasheets etc., shall be handed over to NTPC as per NTPC specifications for handover of Engineering Information.	of the project etc .Complete 3D model along with as built GADs , layout , isometrics , reports extracted and 3D models for all disciplines , with any other document generated from 3D model and naming conventions with as-built updates along with complete reference databases, component catalogues for all the size range shall be handed over to owner. Apart from the 3D Model, all drawings like GADs, Isometrics etc. extracted from the model shall also be submitted by the Contractor in Electronic form. 3D model along with complete Project databases shall be submitted at each model review stage and as final as-built. The contractor shall also submit all the configuration files, customization files, templates and all referenced databases. All input files of software used for design of Equipments / Piping like CAESAR2 files, input files for Pressure vessel design, datasheets etc., shall be handed over to NTPC as per NTPC specifications for handover of Engineering Information. Further, two Licenses of the used 3D Modelling Software (One for Engineering View and One for Site View) shall be provided along with compatible Hardware for possible review and study of the Model Files being submitted by the Bidder Time to time. All software and hardware shall be supplied by bidder within 3 months of NOA. The 3D modelling software shall preferably be the same software bidder will be using for

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					Further, two Licenses of the used 3D Modelling Software (One for Engineering View and One for Site View) shall be provided along with compatible Hardware for possible review and study of the Model Files being submitted by the Bidder Time to time. All software provided shall necessarily include cost for perpetual license(s) for use on all the machines and an Annual maintenance contract (AMC) which shall include software upgrades as & when released by the software agency for a period of three years after warranty/guarantee period . Handover Plan: There shall be continuous handover of documents and data at various stages of the project including rules and trigger points for handover of data to NTPC shall be at 30%, 60% and 90 % of 3D model stage	preparation of 3D model or it shall have all editable features to edit the model supplied by bidder on time to time basis. All software provided shall necessarily include cost for perpetual license(s) for use on all the machines and an Annual maintenance contract (AMC) which shall include software upgrades as & when released by the software agency for a period of three years after warranty/guarantee period . Handover Plan: There shall be continuous handover of documents and data at various stages of the project including rules and trigger points for handover of data to NTPC shall be at 30%, 60% and 90 % of 3D model stage

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MH-1	VI/PART-E				9587-001(R)-POM-A-002 R0 9587-001(R)-POM-A-025 R0 9587-001(R)-POM-A-026 R0 9587-001(R)-POM-A-027 R0 9587-001(R)-POM-A-028 R0 9587-001(R)-POM-A-029 SH1 R0 9587-001(R)-POM-A-029 SH2 R0	9587-001(R)-POM-A-002 R1 9587-001(R)-POM-A-025 R1 9587-001(R)-POM-A-026 R1 9587-001(R)-POM-A-027 R1 9587-001(R)-POM-A-028 R1 9587-001(R)-POM-A-029 SH1 R1 9587-001(R)-POM-A-029 SH2 R1
MH-2	VI/PART-A	IIA-15	2.03.00	5 OF 8	Space and interface provision for one (1) additional stream of Truck Tippler, BRU/Surface Feeder and Bucket Elevator shall be kept for future eventuality.	Space and interface provision for one (1) additional stream of Truck Tippler, BRU/Surface Feeder and Bucket Elevator shall be kept for future eventuality **considering following as a minimum** **a. Ramp to be constructed considering for both truck tippler.** **b. BRU station / building to be sized considering two no's BRU unit & feeding system.** **c. Bucket elevator supporting arrangement shall be considered from silo for two no's bucket elevators.** **d. Silo is to be designed for two streams of conveyor feeding. (One is for St-II + One future stream)** **e. Handling arrangement to be designed considering future equipment also.**
MH-3	VI/PART-A	IIA-15	1.25.00	4 OF 8	**Four (7) Nos.** of suspended magnets on Conveyors complete with reject chutes, reject trolleys, supporting arrangement, and all mechanical, electrical, civil, structural works and accessories	**Five (5) Nos**. of suspended magnets on Conveyors complete with reject chutes, reject trolleys, supporting arrangement, and all mechanical, electrical, civil, structural works and accessories
MH-4	VI/PART-B	A-01	4.02.06	93 OF 101	All mechanical, civil and structural system design shall consider:	All mechanical, **Electrical,** civil and structural system design shall consider:

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<tr><td>MH-5</td><td>VI/PART-A</td><td>CHAPTER-04</td><td>R
5.1
5.2
10
11
18
22</td><td>11 OF 20</td><td>R) Mandatory Spares for STACKER/RECLAIMER

Mechanical

5.1 Hydraulic pump & hydraulic motor drive for luffing system

5.2 Hydraulic pump & hydraulic motor drive for slew mechanism

10. Slew gear Box

11. Gear Box of bucket wheel

18. Chain & chain sprockets

22. Plummer block with bearing for cable reel drums</td><td>R) Mandatory Spares for STACKER/RECLAIMER

5.1 Hydraulic pump & hydraulic motor (if applicable) drive for luffing system

5.2 Hydraulic pump & hydraulic motor drive for slew mechanism (As applicable)

10 Slew gear Box (As applicable)

11. deleted

18. Chain & chain sprockets (if applicable)

22. deleted</td></tr>
<tr><td>MH-6</td><td>VI/PART-B</td><td>A-01</td><td>4.02.06</td><td>94 OF 101</td><td>Design capacities & margins
<table><tr><td>Sl no</td><td>Equipment</td><td>Duty requirement</td><td>Design capacity as %age of duty requirement</td></tr><tr><td>3</td><td>Paddle feeders</td><td>2 X75%</td><td>150%</td></tr></table></td><td>Design capacities & margins
<table><tr><td>Sl no</td><td>Equipment</td><td>Duty requirement</td><td>Design capacity as %age of duty requirement</td></tr><tr><td>5</td><td>Paddle feeders</td><td>2 X75%</td><td>110%</td></tr></table></td></tr>
</table>

EPC PACKAGE FOR LARA SUPER THERMAL POWER PROJECT, STAGE-II (2x800 MW)
Amendment No. 02 to Technical Specifications Section-VI of Bidding Document No.: CS-9587-001R-2

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MH-7	VI/PART-A	IIA-15	2.07.00	6 OF 8	Two numbers (2 Nos) of Mechanical Extractor & Biomass Feeder below each **limestone** storage silos with drives, dust hoods (for Feeder), all mechanical, electrical accessories and supporting structures etc to feed the Biomass to downstream conveyors.	Two numbers (2 Nos) of Mechanical Extractor & Biomass Feeder below each **Biomass** storage silos with drives, dust hoods (for Feeder), all mechanical, electrical accessories and supporting structures etc to feed the Biomass to downstream conveyors. Mechanical extractor also known as Silo extractor/Rotary extractor, is a machine for efficiently extracting materials having poor natural flowing properties such as fibrous, wet materials prone to blockage. Bidder to provide Silo extractor/Rotary extractor consists of rotating chute, extractor blade/sweeper arm/paddle wheel, slewing arrangement etc.
MH-8	VI/PART-B	A-01	4.01.02	88 OF 101	**Broad Design Criteria** **(F) Ash slurry disposal system** **Combined Ash slurry disposal system** **h)** Maximum pumping distance – **6.0 Km** or as per actual distance for the farthest disposal point in ash dyke whichever is higher	**Broad Design Criteria** **(F) Ash slurry disposal system** **Combined Ash slurry disposal system** **h)** Minimum pumping distance – **6.5 Km** or as per actual distance for the farthest disposal point in ash dyke whichever is higher
MH-9	VI/PART-B	A-01	4.01.04	91 OF 101	**Standby arrangement for Ash handling system** Combined Ash Disposal System- Two pump streams operating with **One pump stream as operating standby per unit.** Independent pipelines for each pump stream	**Standby arrangement for Ash handling system** Bottom Ash Slurry Ash Disposal System- **One pump stream as operating standby and one pump stream as maintenance standby**. Independent pipelines for each pump stream
MH-10	VI/PART-A	IIA-16	1.01.05	5 OF 15	Nine (9) nos. dewatering storage bins (3 nos. for each unit and 3 nos standby) ……...for safe and reliable operation and maintenance of dewatering bins.	Nine (9) nos. dewatering storage bins (3 nos. for each unit and 3 nos **common** standby) ……...for safe and reliable operation and maintenance of dewatering bins.

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MH-11	VI/PART-B	A-21	1.12.00	15 OF 44	DEWATERING BINS 1.0 Numbers required : 3 NO PER UNIT(Out of three (3) nos.dewatering bins provided for each unit, one(1) no. shall be under filling, one (1) no. shall be under decantation 2.0 Capacity: As per design criteria (Minimum 8 hours of Bottom ash storage)	DEWATERING BINS 1.0 Numbers required : 3 NO PER UNIT(Out of three (3) nos.dewatering bins provided for each unit, one(1) no. shall be under filling, one (1) no. shall be under decantation, **one (1) no. shall be under evacuation** **03 No Dewatering Bins as Common standby for both units** **2.0** Capacity: As per design criteria (Minimum 8 hours generation of Bottom ash, economizer ash, air preheater ash, SCR ash (as applicable), duct ash (as applicable) while firing worst coal.)
MH-12	VI/PART-A	IIA-16	1.01.06 (A)	6 OF 15	(III) **Six (6) lengths** of Dry fly ash Cast Iron / MS piping from ESP Hopper outlets onwards up to Ash classifier system complete with valves, specialties, bends, pneumatic actuators, structural steel supports, platforms etc.	(III) **Eight (8) lengths** for each unit of Dry fly ash Cast Iron / MS piping from ESP Hopper outlets onwards up to Ash classifier system complete with valves, specialties, bends, pneumatic actuators, structural steel supports, platforms etc.
MH-13	VI/PART-A	IIA-16	1.01.06 (B)	7 OF 15	Dry Fly Ash Transportation system from Buffer Hoppers to Ash Classifier System (d) **Four (4) lengths** of cast iron/MS pipes for each unit for fly ash transportation from buffer hoppers to Classifier Block including pipe rack, platforms, access stairs and other associated supporting steel structure and other accessories as required.	Dry Fly Ash Transportation system from Buffer Hoppers to Ash Classifier System (d) **Six (6) lengths** of cast iron/MS pipes for each unit for fly ash transportation from buffer hoppers to Classifier Block including pipe rack, platforms, access stairs and other associated supporting steel structure and other accessories as required.
MH-14	VI/PART-B	A-01	4.01.02	89 OF 101	Storage capacity for Classifier Block Silos/Hoppers are as follows: - Fine fly ash Hopper-600 (T), Coarse Fly ash Hopper-600 (T), Classifier Silo -250 (T).	Storage capacity for Classifier Block Silos/Hoppers are as follows: - **Fine fly ash Hopper-300 (T), Coarse Fly ash Hopper- 2 x 300 (T), Classifier Silo -250 (T).**

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MH-15	VI/PART-A	IIA-16	1.01.06	8 OF 15	(D) ASH CLASSIFICATION AND BAGGING SYSTEM (e) The fine ash and coarse ash after classification shall be stored in separate RCC hoppers, fine ash hopper and coarse ash hopper respectively. The capacity of the **fine ash hopper and coarse ash hopper shall be 600 Tonnes each.**	(D) ASH CLASSIFICATION AND BAGGING SYSTEM (e) The fine ash and coarse ash after classification shall be stored in separate RCC/**Structural steel** hoppers, fine ash hopper and coarse ash hopper respectively. The capacity of the **fine ash hopper (01 No) and coarse ash hopper (02 No) shall be 300 Tonnes.**
MH-16	VI/PART-A	IIA-16	1.01.06	8 OF 15	(D) ASH CLASSIFICATION AND BAGGING SYSTEM (f) **Eight (8) nos**. Pump tanks/Air lock tank for each coarse ash hopper and four (4) nos. of pump tanks/air locks tank for fine ash hopper for transportation of coarse fly ash and fine fly ash respectively, to silos provided for dry fly ash storage silos meant for Road and Rail loading. Provisions shall be provided to convey & store Fine Ash to another Coarse Fly ash Silo in addition to Fine Fly Ash Silo.	(D) ASH CLASSIFICATION AND BAGGING SYSTEM (f) **Ten (10) nos**. Pump tanks/Air lock tank for each coarse ash hopper and four (4) nos. of pump tanks/air locks tank for fine ash hopper for transportation of coarse fly ash and fine fly ash respectively, to silos provided for dry fly ash storage silos meant for Road and Rail loading. Provisions shall be provided to convey & store Fine Ash to another Coarse Fly ash Silo in addition to Fine Fly Ash Silo
MH-17	VI/PART-A	IIA-16	1.01.06	8 OF 15	(D) ASH CLASSIFICATION AND BAGGING SYSTEM (m) Required lengths of cast iron/MS pipes **(at least two standby lines for two units)** for coarse fly ash conveying from coarse fly ash hoppers to three fly ash storage silos located in the fly ash silo complex. Required lengths of cast iron/MS pipes for fine fly ash conveying from Fine fly ash hoppers to Fine fly ash storage silo .	(D) ASH CLASSIFICATION AND BAGGING SYSTEM (m) Required lengths of cast iron/MS pipes **(two standby lines for each unit)** for coarse fly ash conveying from coarse fly ash hoppers to three fly ash storage silos located in the fly ash silo complex. Required lengths of cast iron/MS pipes for fine fly ash conveying from Fine fly ash hoppers to Fine fly ash storage silo.
MH-18	VI/PART-A	IIA-16	1.01.07	10 OF 15	Dry Fly Ash Storage System (i) **Eight (8)** numbers of twin shaft paddle type/rotary drum type hydro-mix conditioner units along with drive motor, rotary feeder, **Two (2)** number for each silo, along with associated water piping and valves, for unloading the conditioned fly ash into trucks.	Dry Fly Ash Storage System (i) **Four (4)** numbers of twin shaft paddle type/rotary drum type hydro-mix conditioner units along with drive motor, rotary feeder, **One (1)** number for each silo, along with associated water piping and valves, for unloading the conditioned fly ash into trucks.

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MH-19	VI/PART-A	IIA-16	1.01.07	10 OF 15	Dry Fly Ash Storage System K) **Four (4)** numbers of Dry fly ash unloaders from each dry fly ash storage silo along with rotary feeders, telescopic chutes and other accessories as specified and as required.	Dry Fly Ash Storage System K) **Five (5)** numbers of Dry fly ash unloaders from each dry fly ash storage silo along with rotary feeders, telescopic chutes and other accessories as specified and as required.
MH-20	VI/PART-A	IIA-16	1.01.07	9 OF 15	Mass flow meter/Solid flow meter (**Two** numbers below each silo) complete with all electrical, controls etc to be provided for measurement of ash quantity (total or part, as required) during filling of ash to the road tanker/Rail Wagons.	Mass flow meter/Solid flow meter (**Five** numbers below each silo) complete with all electrical, controls etc to be provided for measurement of ash quantity (total or part, as required) during filling of ash to the road tanker/Rail Wagons.
MH-21	VI/PART-A	IIA-16	1.01.08	11 OF 15	Six (6) lengths seamless steel pipes with fittings for high concentration slurry disposal from HCSD pumps upto plant boundry.	Six (6) lengths seamless steel pipes **of 175 NB diameter** with fittings for high concentration slurry disposal from HCSD pumps upto plant boundry.
MH-22	VI/PART-B	A-21	5.01.02	36 OF 44	Combined Fly ash and bottom ash in high concentration form shall be disposed off in the ash disposal area earmarked for stacking ash slurry and routing of HCSD pipes inside ash dyke including garlanding of dyke and routing of ash pipeline inside the disposal area is in bidder's scope.	Combined Fly ash and bottom ash in high concentration form shall be disposed off in the **Bottom** ash disposal area. **The routing of HCSD pipes inside plant boundary is in bidder's scope.**
MH-23	VI/PART-A	IIA-16	1.02.01. 02	13 OF 15	i) Decanted water shall be pumped from owners' pumping system located at ash dyke. There shall be one no. working AWRS Pump of 400 m3/hr flow rate (owners' pumping system), is envisaged. Hence, maximum recovery water received inside plant shall be 400 m3/hr, accordingly pipeline within plant boundary upto terminal point shall be in Bidders scope.	i) Decanted water shall be pumped from owners' pumping system located at ash dyke. There shall be one no. working AWRS Pump of **600 m3/hr** flow rate (owners' pumping system), is envisaged. Hence, maximum recovery water received inside plant shall be **600 m3/hr**, accordingly pipeline of **400NB** diameter within plant boundary upto terminal point shall be in Bidders scope.

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<tr><td>MH-24</td><td>VI/PART-B</td><td>A-21</td><td>4.00.00</td><td>31 OF 44</td>
<td>ASH DISPOSAL PIPING AND ACCESSORIES

<table>
<tr><td>Location</td><td>i)</td><td>For BA transportation from boiler area upto slurry sump of BA slurry disposal pump house.
For BA transportation from jet pump discharge upto bottom/combined ash slurry sump.</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td>ii)</td><td>From the ash slurry disposal pump discharge upto disposal point at the Mine Void/Ash Dyke.</td></tr>
<tr><td>Type</td><td>a)</td><td>20 thk. Cast basalt lined MS (MS shell of 6.00 mm thick) piping for BA slurry transportation from boiler area up to slurry sump of Combined/BA slurry pump house and slurry disposal pipes within ash slurry pump house & in culverts/trenches at rail/road crossings.</td></tr>
<tr><td></td><td>b)</td><td>ERW/SAW pipes of grade Fe-410 as per API-5L Gr. B/IS:3589 (9.5 mm thick for slurry disposal pipes to from Combined/ BA slurry pump house to Mine void/Ash dyke.</td></tr>
</table>
</td>
<td>ASH DISPOSAL PIPING AND ACCESSORIES

<table>
<tr><td>Location</td><td>i)</td><td>For BA transportation from boiler area upto slurry sump of BA slurry disposal pump house.

For BA transportation from jet pump discharge upto bottom ash slurry sump.</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td>ii)</td><td>From the ash slurry disposal pump discharge upto disposal point at the Dewatering Bins</td></tr>
<tr><td>Type</td><td>a)</td><td>20 thk. Cast basalt lined MS (MS shell of 6.00 mm thick) piping for BA slurry transportation from boiler area up to slurry sump of BA slurry pump house and slurry disposal pipes within ash slurry pump house, From the ash slurry disposal pump discharge upto disposal point at the Dewatering Bins, in culverts/trenches at rail/road crossings.</td></tr>
<tr><td>b)</td><td></td><td>DELETED</td></tr>
</table>
</td></tr>
</table>

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MH-25	VI/PART-B	**A-01**	**4.03.03**	98 of 101	In case of mechanical conveying system, a vibrating feeder and metallic belt/chain flight conveyor carry mill reject from hopper to subsequent metallic /chain flight conveyor for further conveying to Bucket elevator for final storage at Silo.	In case of mechanical conveying system, a vibrating feeder **(if required)** and metallic belt/chain flight conveyor carry mill reject from hopper to subsequent metallic /chain flight conveyor for further conveying to Bucket elevator for final storage at Silo.
MH-26	VI/PART-B	**A-20**	**4.12.00 c)**	**88 OF 93**	Coal Sampling system: All necessary automatic controls shall be provided for meeting the requirements of ASTM-D-2234.	Coal Sampling system: All necessary automatic controls shall be provided for meeting the requirements of IS: 16143 (Part 2) & IS: 16143 (Part 4).
MH-27	VI/PART-B	**A-21**	**3.08.00**	**30 OF 44**	Dry Ash unloader, Conditioned Ash unloader, Telescopic chute: Capacity range 40-100 TPH during open Truck/Bulker loading **through Condition ash unloader / Dry Ash unloader** 40-300 TPH for Truck/Bulkar/Rail Wagon Loading through Dry Ash unloader	Dry Ash unloader, Conditioned Ash unloader, Telescopic chute: Capacity range 40-100 TPH during open Truck/Bulker loading **through Condition ash unloader** 40-300 TPH for Truck/Bulkar/Rail Wagon Loading **through Dry Ash unloader**
MH-28	VI/PART-B	**A-21**	**2.12.00**	**23 OF 44**	Classifier Silo/Intermediate FA Silo: Flat bottom/Conical type with proven design with respect to Flowability of ash. **Intermediate FA Silo shall necessarily be conical type only**	Classifier Silo/Intermediate FA Silo: Flat bottom/Conical type with proven design with respect to Flowability of ash.
MH-29	VI/PART-B	**A-01**	**4.01.02 (B) (a)**	**86 OF 101**	Ash removal rate shall meet the following criteria: Fly Ash System- 8 hours collection shall be removed in 6 hours for ESP Ash. The conveying system shall be designed to evacuate ash generated both during normal mode and	Ash removal rate shall meet the following criteria: Fly Ash System- 8 hours collection shall be removed in 6 hours for ESP Ash **(From ESP to Coarse fly ash hopper/Fine fly ash hoppers and**

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					SCR Bypass mode. The ash conveying rate from ESP hoppers must be designed considering two fields out of service condition at any one time.	**From Coarse fly ash hopper/Fine fly ash hoppers to Fly ash Silos having Road cum Rail loading facilities)** The conveying system shall be designed to evacuate ash generated both during normal mode and SCR Bypass mode. The ash conveying rate from ESP hoppers must be designed considering two fields out of service condition at any one time.
MH-30	**VI/PART-B**	**A-20**	**4.4.3**	**8 OF 93**	Skirt Board Skirt board shall ensure ……..one edge of the skirt. Skirt sealing **Plate** of each side shall be in single piece.	Skirt Board Skirt board shall ensure ……..one edge of the skirt. Skirt sealing **material** of each side shall be in single piece.
MH-31	**VI/PART-B**	**A-20**	**4.11.6 (B) a) (i)**	**17 OF 93**	Fogging system & controls consisting of: Cold Fog producing Nozzles (SS 316 body), Nozzles orifice shall be suitably protected with Anti-abrasive material **(Ruby).**	Fogging system & controls consisting of: Cold Fog producing Nozzles (SS 316 body), Nozzles orifice shall be suitably protected with Anti-abrasive material
MH-32	**VI/PART-A**	**1A**	**4.19.3 (c)**	**14 OF 36**	Design and Engineering Agency for High Concentration Slurry Disposal System: Design agency/agencies for high concentration slurry disposal system should be either an high concentration slurry disposal system supplier meeting the qualification of **clause 2.3.1 (d),** for the offered system or consultancy organization who has designed and engineered similar system(s) for handling not less than 40 tonnes of ash per hour, for pulverized coal fired power station(s) and the system(s) should have been in successful operation in at least one (1) plant for at least	Design and Engineering Agency for High Concentration Slurry Disposal System: Design agency/agencies for high concentration slurry disposal system should be either an high concentration slurry disposal system supplier meeting the qualification of **clause 4.19.1 (d),** for the offered system or consultancy organization who has designed and engineered similar system(s) for handling not less than 40 tonnes of ash per hour, for pulverized coal fired power station(s) and the system(s) should have been in

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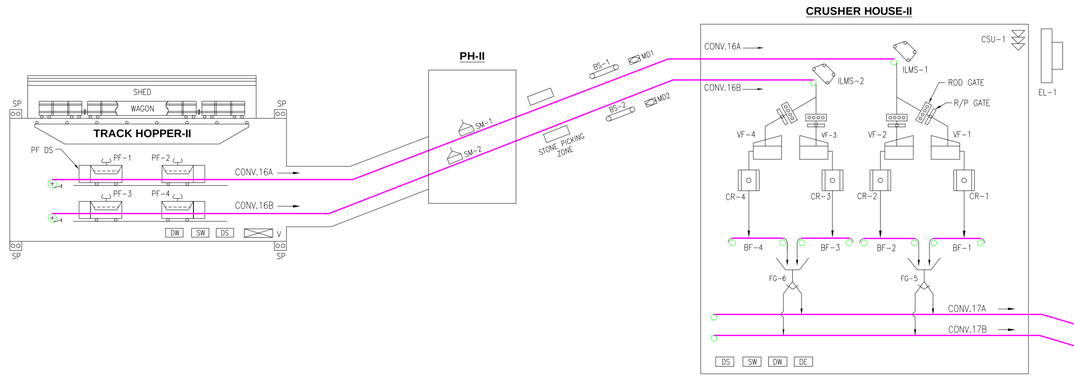
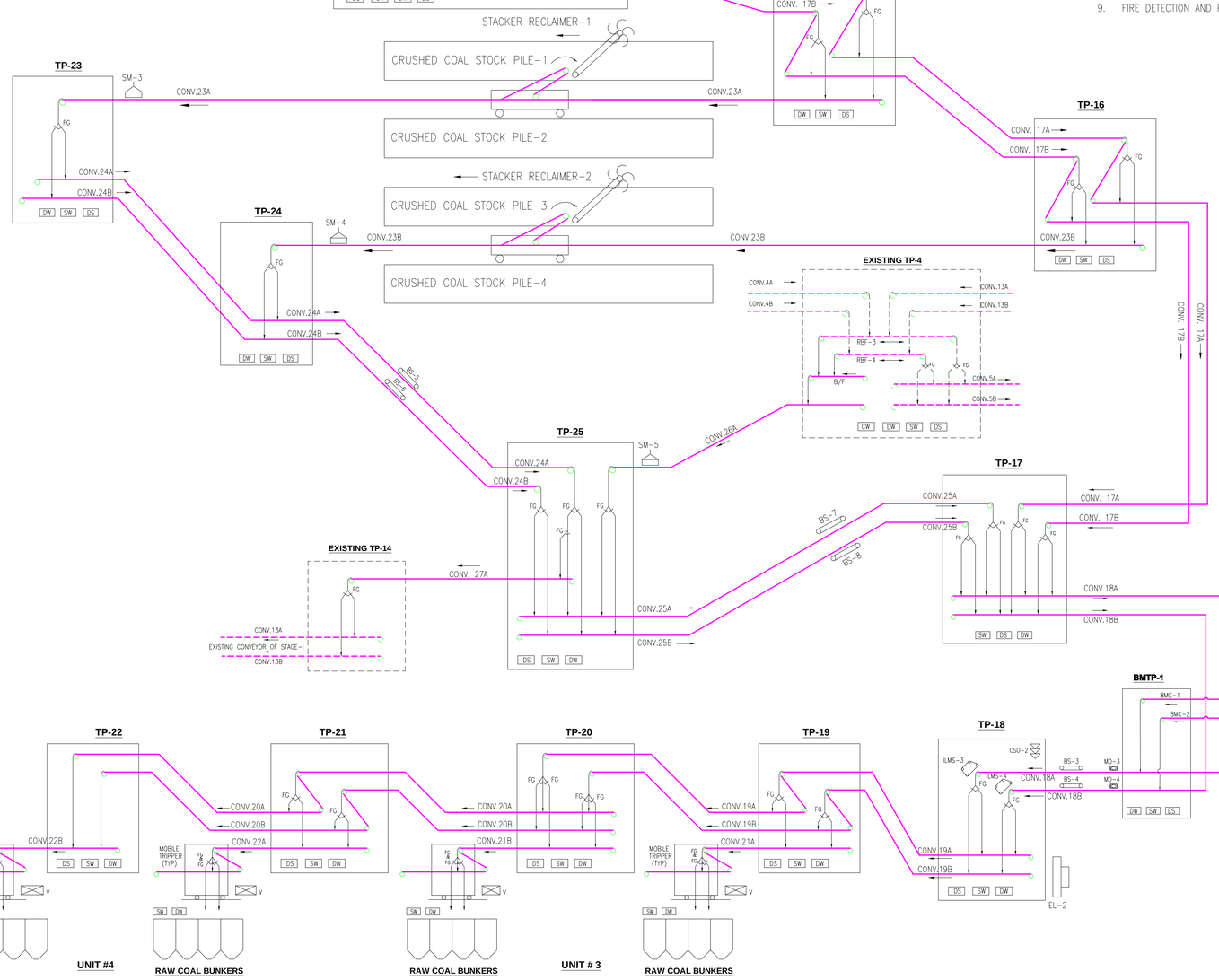
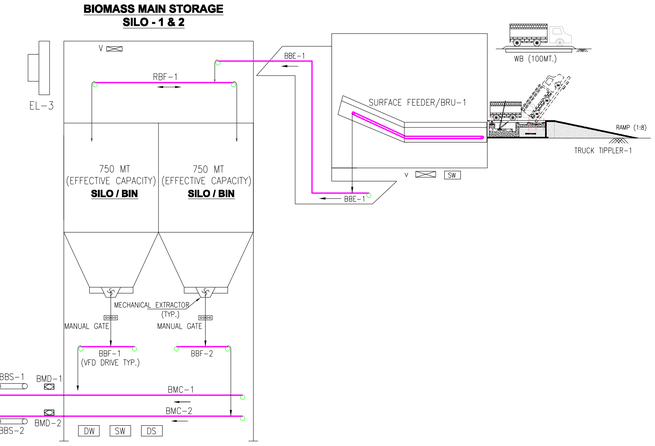
					two (2) years prior to the date of Techno-Commercial bid opening.	successful operation in at least one (1) plant for at least two (2) years prior to the date of Techno-Commercial bid opening.
MH-33	**VI/PART-B**	**A-21**	**5.01.00 (4)**	**33 OF 44**	HORIZONTAL CENTRIFUGAL PUMPS Nos. operating BAHP Water pump: 2 working + 1standby BALP Water pump: **3 working + 2 standby** FAHP Water pump: **3 working + 2 standby** Flushing water pump **(If applicable):** 1x100% BA Seal water pump: 1working +1standby Eco/APH ash water pump : 2 working+ 1 standby Conditioning Water pumps: 2 Working for HCSD cum storage silo + 1 standby Wash water pumps: 1working +1standby	HORIZONTAL CENTRIFUGAL PUMPS Nos. operating BAHP Water pump: 2 working + 1standby BALP Water pump: **2 working + 1 standby** FAHP Water pump: **2 working + 1 standby** Flushing water pump : 1x100% BA Seal water pump: 1working +1standby Eco/APH ash water pump : 2 working+ 1 standby Conditioning Water pumps: 2 Working for HCSD cum storage silo + 1 standby Wash water pumps: 1working +1standby







NOTES :

1. THIS DRG. IS MEANT TO SHOW ONLY COAL FLOW PATH AND DOES NOT INDICATE COMPREHENSIVE SCOPE OF WORK. THE NOS. OF TPs SHOWN IS INDICATIVE. BIDDER MAY OPTIMIZE THE LAYOUT MEETING THE FUNCTIONAL AND TECHNICAL REQUIREMENTS.
2. ALL CONVEYORS SHALL BE PROVIDED WITH ACCESSORIES SUCH AS PULL CORD, BELT SWAY AND ZERO SPEED SWITCHES, BELT WIPER UNITS, TENSIONING DEVICES ETC. AS PER TECHNICAL SPECIFICATION. THESE ARE NOT SHOWN IN THE FLOW DIAGRAM FOR CLARITY.
3. ALL ACCESSORIES, ITEMS OF WORK, THOUGH NOT INDICATED BUT REQUIRED TO MAKE THE SYSTEM COMPLETE FOR ITS SAFE, EFFECIENT, RELIABLE AND TROUBLE FREE OPERATION AND MAINTENANCE SHALL ALSO BE INCLUDED IN BIDDER'S SCOPE UNLESS SPECIFICALLY EXCLUDED.
4. DUST SUPPRESSION, SERVICE WATER, POTABLE WATER, COOLING WATER, DUST EXTRACTION & VENTILATION SHALL BE PROVIDED AS PER TECHNICAL SPECIFICATION REQUIREMENT.
5. BELT WEIGHER IN STACKER RECLAIMER MACHINE NOT SHOWN FOR CLARITY IS IN BIDDER'S SCOPE OF SUPPLY & SHALL BE AS PER TECH SPECIFICATION.
6. THIS TENDER DRAWING IS TO BE REVIEWED IN CONJUNCTION WITH THE TECHNICAL SPECIFICATIONS.
7. PROVISION FOR RECEIVING COAL FROM STAGE-I TO STAGE-II AND STAGE -II TO STAGE-I TO BE PROVIDED AT SUITABLE LOCATION.
8. ALL CONVEYING STREAMS FOR BIOMASS SHALL BE WORKING. NO STAND BY STREAM HAS BEEN ENVISAGED. FROM TRUCK TIPPLER UPTO STORAGE SILO, ONE ADDITIONAL BIOMASS STREAM SHALL BE KEPT AS FUTURE PROVISION
9. FIRE DETECTION AND PROTECTION SYSTEM SHALL BE AS SPECIFIED ELSEWHERE.

LEGEND

	BELT FEEDER
DS	DUST SUPPRESSION SYSTEM
SW	SERVICE WATER SYSTEM
DW	DRINKING WATER SYSTEM
DE	DUST EXTRACTION SYSTEM
SP	SUMP & SUMP DRAINAGE PUMPS
	BELT CONVEYOR
BS	BELT SCALE
CSU	COAL SAMPLING UNIT
DS	DUST SUPPRESSION-PF
ILMS	MAGNETIC SEPARATOR (IN LINE)
MD	METAL DETECTOR
PF	PADDLE FEEDER
V	VENTILATION
FG	FLAP GATE
	ROD GATE
	RACK & PINION GATE
CR	CRUSHER
VF	VIBRO FEEDER
SM	SUSPENDED MAGNET
EL	CONVENTIONAL ELEVATOR

EQPT. DESIGN.	EQUIPMENT	QTY.	CAPACITY
DS	DUST SUPPRESSION SYSTEM	LOT	
EL	PASSENGER CUM GOODS ELEVATOR CH, TP-18 & BMS	3	1 TON
SP	SUMP PUMP	LOT	
BF-1 TO 4	BELT FEEDER	4	1320 TPH
MT	MOBILE TRAVELLING TRIPPERS	4	2400 TPH
SR	STACKER RECLAIMER	2	2400 TPH
PH-II	PENT HOUSE	1	
	SURFACE FEEDER/BRU	1	240 TPH
BMD	BIOMASS METAL DETECTOR	2	
BBS	BIOMASS BELT WEIGH SCALE	2	
BBE 1	BIOMASS BUCKET ELEVATOR	1	240 TPH
RBF-1	REVERSIBLE BELT FEEDER	1	240 TPH
BMC1&2	BIOMASS CONVEYOR	2	240 TPH
BBF1&2	BIOMASS BELT FEEDER	2	240 TPH
27A	CONVEYOR 1800 mm WIDE	1	2400 TPH
26A	CONVEYOR 1800 mm WIDE	1	2400 TPH
25A/25B	CONVEYOR 1800 mm WIDE	2	2400 TPH
24A/24B	CONVEYOR 1800 mm WIDE	2	2400 TPH
23A/23B	YARD CONVEYOR 1800 mm WIDE	2	2400 TPH
22A/22B	CONVEYOR 1800 mm WIDE	2	2400 TPH
21A/21B	CONVEYOR 1800 mm WIDE	2	2400 TPH
20A/20B	CONVEYOR 1800 mm WIDE	2	2400 TPH
19A/19B	CONVEYOR 1800 mm WIDE	2	2400 TPH
18A/18B	CONVEYOR 1800 mm WIDE	2	2400 TPH
17A/17B	CONVEYOR 1800 mm WIDE	2	2400 TPH
16A/16B	CONVEYOR 1800 mm WIDE	2	2400 TPH
MD	METAL DETECTOR	4	
SM	SUSPENDED MAGNET	5	
VF 1-4	VIBRATING FEEDER	4	1320 TPH
CSU-1 CSU-2	COAL SAMPLING UNIT (-)250mm SIZE COAL SAMPLING UNIT (-)20mm SIZE	1 1	
CH-II	CRUSHER	4	1320 TPH
FG	FLAP GATE	LOT	
BS	BELT WEIGH SCALE	8	
RPG	RACK AND PINION GATE	4	
RG	ROD GATE	4	
ILMS	IN LINE MAGNETIC SEPARATOR ALONG WITH TRAMP IRON CHUTE	4	
PF 1-4	PADDLE FEEDER	4	1800 TPH

FOR TENDER PURPOSE ONLY

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	C	M	E	C&I	APPD	DATE
B	RELEASED FOR TENDER									
A	RELEASED FOR TENDER	Priyanka	MK							

CLEARED BY

एन टी पी सी NTPC

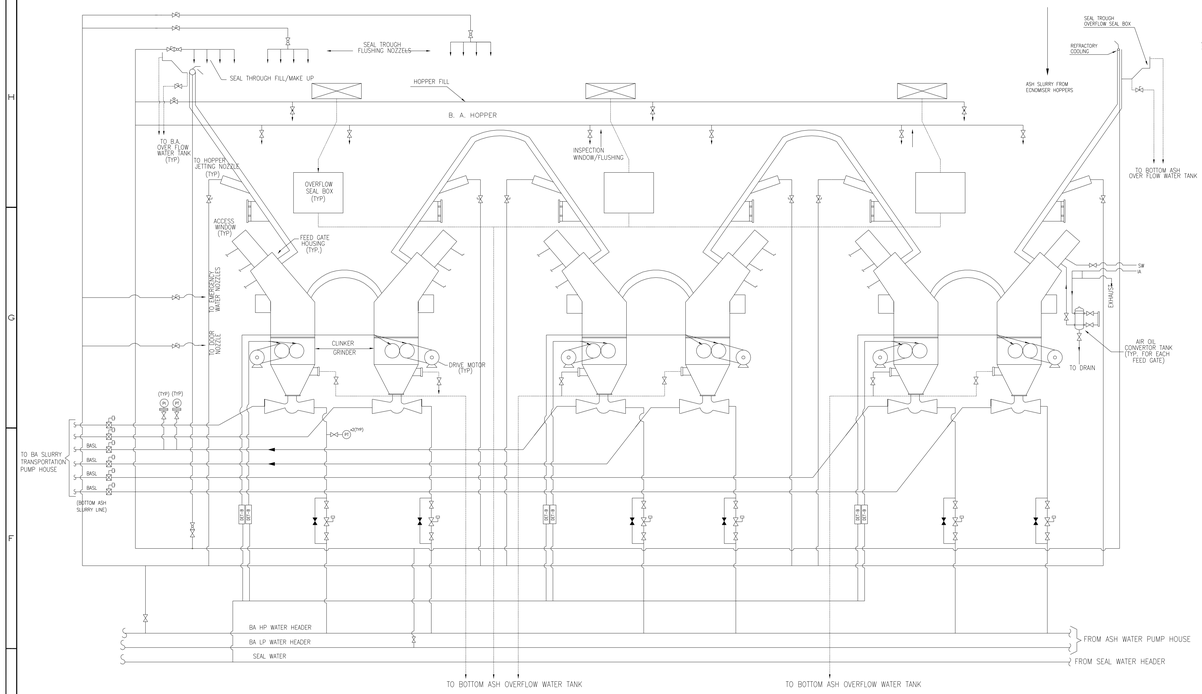
NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: **LARA SUPER THERMAL POWER PROJECT**
STAGE-II (2x800MW)

TITLE: COAL & BIOMASS HANDLING PLANT PACKAGE
COAL + BIOMASS FLOW DIAGRAM

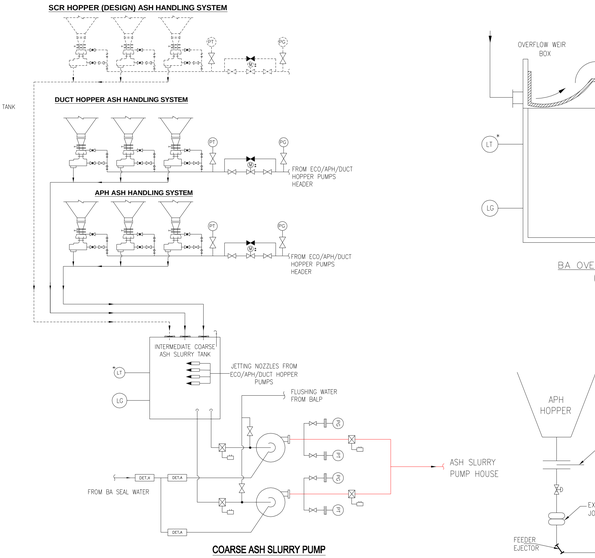
SIZE	SCALE	DRG.NO.	REV.
A1	--	9587-001(R)-POM-A-002	B

CAD FILE NAME : 9587-001(R)-POM-A-002.dwg

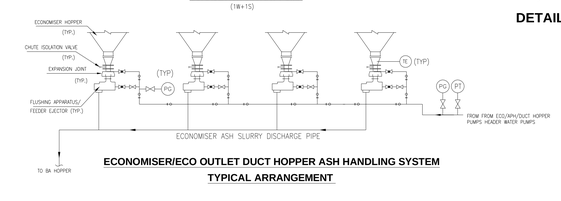


JET PUMP SYSTEM FOR UNIT # 1
(SHALL BE IDENTICAL FOR UNIT # 2)

TYPICAL ARRANGEMENT OF COARSE ASH HANDLING SYSTEM

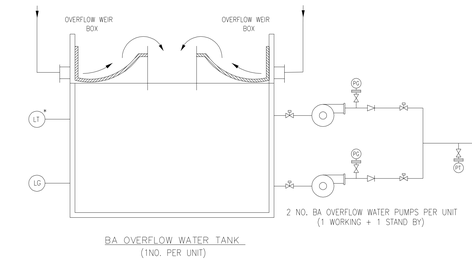


COARSE ASH SLURRY PUMP
(1W+1S)

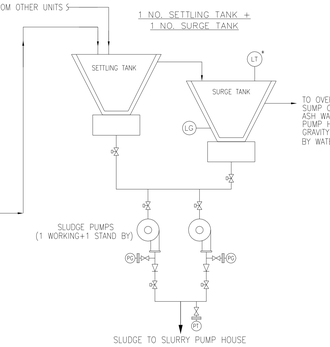


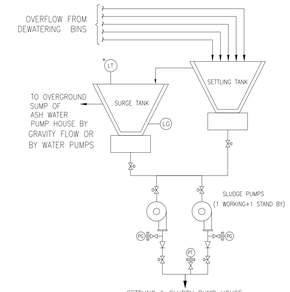
ECONOMISER/ECO OUTLET DUCT HOPPER ASH HANDLING SYSTEM
TYPICAL ARRANGEMENT

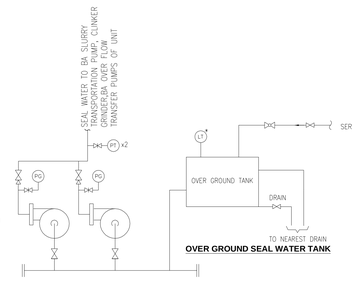
DETAIL-A



BA OVERFLOW WATER TANK
(1NO. PER UNIT)



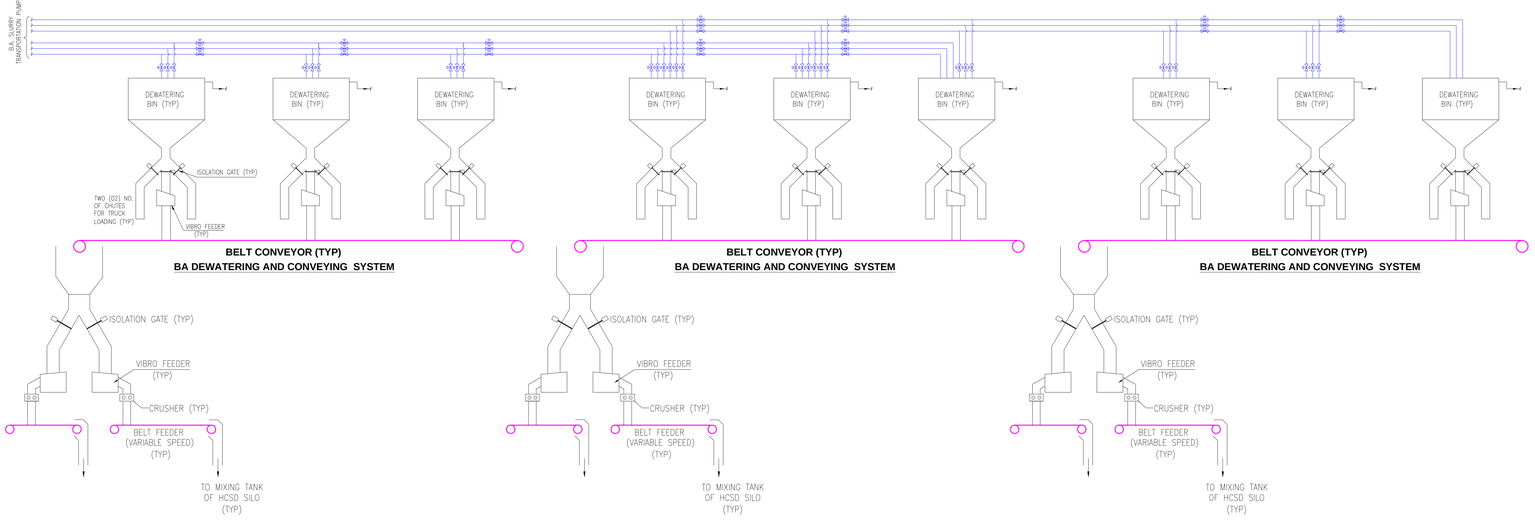




BA SEAL WATER PUMPS (PER UNIT)
(1 WORKING + 1 STANDBY)

OVER GROUND SEAL WATER TANK

B.A. SLURRY TRANSPORTATION PUMPS HOUSE
(FOR UNIT # 1)
(SHALL BE IDENTICAL FOR UNIT # 2)



BELT CONVEYOR (TYP)
BA DEWATERING AND CONVEYING SYSTEM

ASH WATER PUMP HOUSE
(COMMON FOR BOTH UNITS)

TYPICAL INSTRUMENT AIR CONNECTION

LEGEND :

	PLUG VALVE		SOLENOID VALVE
	GLOBE VALVE		MOTORISED VALVE
	NON RETURN VALVE		ASH SLURRY DUTY VALVE (PNEUMATICALLY OPERATED)
	ISOLATION VALVE	PT	PRESSURE TRANSMITTER
	ISOLATION VALVE (PNEUMATICALLY OPERATED)	LT	LEVEL TRANSMITTER (ULTRASONIC TYPE)
	RELIEF VALVE	LG	LEVEL GAUGE
	PUMP		INSTRUMENT VALVE
PS	PRESSURE SWITCH	IA	INSTRUMENT AIR LINE
PG	PRESSURE GAUGE	BASL	BOTTOM ASH SLURRY LINE
DPG	DIFFERENTIAL PRESSURE GUAGE		DIAPHRAGM SEAL
	STRAINER		FLOW INDICATOR
LG	LEVEL INDICATOR	LS	LEVEL SWITCH
			PNEUMATIC VALVE

NOTES

1. BOTTOM ASH / ECO ASH / APH ASH / SCR ASH / DUCT HOPPER ASH HANDLING SYSTEM SHOWN IS INDICATIVE, COMPLETE ASH HANDLING SYSTEM SHALL BE DESIGNED & SUPPLIED MEETING FUNCTIONAL REQUIREMENTS FOR BOTH UNITS, THE NOS. OF ECONOMISER AND AIR PREHEATER HOPPERS SHALL BE DECIDED BY BIDDER.
2. THE SCHEME & NO. OF PUMPS/EQUIPMENT SHALL BE FINALISED BASED ON STIPULATIONS OF TECHNICAL SPECIFICATION & SYSTEM REQUIREMENTS.
3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH TECH.SPECS. AND OTHER TENDER DOCUMENTS, BIDDER MAY OPTIMIZE THE LAYOUT MEETING THE FUNCTIONAL AND TECHNICAL REQUIREMENTS.
4. INSTRUMENTS SHOWN ARE INDICATIVE ONLY. COMPLETE INSTRUMENTATION SHALL BE PROVIDED AS PER SYSTEM & FUNCTIONAL REQUIREMENTS SPECIFIED.
5. THE BOTTOM ASH HOPPER OVERFLOW WATER SHALL BE LED TO AN OVERFLOW TANK. BOTTOM ASH OVERFLOW WATER PUMP SHALL TAKE SUCTION FROM THIS OVERFLOW TANK AND PUMP THE WATER TO THE REQUIRED TREATMENT FACILITIES. SUITABLE CHEMICAL TREATMENT / FILTRATION / CLARIFICATION ETC. SHALL BE PROVIDED SO THAT TSS OF OUTLET WATER AT DISCHARGE OF SETTLING TANK/SURGE TANK SHALL NOT BE MORE THAN 100 PPM BEFORE THE WATER IS BEING DISCHARGED TO THE SUMP OF ASH WATER PUMP HOUSE.
6. OVER FLOW FROM DEWATERING BINS SHALL BE TAKEN TO SETTLING TANK.SUITABLE CHEMICAL TREATMENT/ FILTRATION / CLARIFICATION ETC. SHALL BE PROVIDED SO THAT TSS OF OUTLET WATER AT DISCHARGE OF SETTLING TANK/SURGE TANK SHALL NOT BE MORE THAN 100 PPM BEFORE THE WATER IS BEING DISCHARGED TO THE SUMP OF ASH WATER PUMP HOUSE.
7. THE ASH SLURRY PIPING FROM THE DISCHARGE OF JET PUMP UP TO BA SLURRY TRANSPORTATION PUMP HOUSE SHALL BE BASALT LINED. ASH SLURRY TRANSPORTATION PIPING WITH IN BA PUMP HOUSE AND UP TO DEWATERING BINS SHALL BE BASALT LINED.
8. FOR MEETING THE FLUSHING APPARATUS WATER REQUIREMENT OF ECO HOPPERS, THREE(3) NOS. (TWO WORKING AND ONE STANDBY) ECONOMISER ASH WATER PUMPS ALONG WITH VALVES, PIPES & FITTINGS SHALL BE PROVIDED FOR ALL UNITS.THESE PUMPS SHALL BE LOCATED IN ASH WATER PUMP HOUSE.
9. FOR SEALING OF BA COOLING WATER OVERFLOW PUMPS, COOLING OF BA OVERFLOW PUMP FLUID COUPLING, SEALING OF CLINKER GRINDERS ETC, BIDDER SHALL PROVIDE TWO (2) NOS. (1 WORKING + 1 STANDBY) SEAL WATER PUMPS FOR ALL UNITS.
10. LIMIT SWITCHES ARE TO BE PROVIDED FOR MANUAL VALVES AS PER SYSTEM REQUIREMENTS & CONTROL PHILOSOPHY.
11. FOR ALL INSTRUMENTS AND DRIVES, SUPPLIER TO ASSIGN UNIQUE TAG NUMBERS FOR IDENTIFICATION. THIS TAG NUMBERS SHALL BE INDICATED ON DOCUMENTS/DRAWINGS/DATA SHEETS APPLICABLE FOR THE RESPECTIVE INSTRUMENT/DRIVE.
12. FOR SEALING OF BA SLURRY TRANSPORTATION PUMPS, BIDDER SHALL PROVIDE TWO (2) NOS. (1 WORKING + 1 STANDBY) BA SEAL WATER PUMPS PER UNITS. THESE PUMPS SHALL BE LOCATED IN THE BA SLURRY TRANSPORTATION PUMP HOUSE.
13. RECIRCULATION LINE ALONG WITH VALVES AND INSTRUMENTATION IN ASH WATER PUMPS SHALL BE PROVIDED.
14. ALL ACCESSORIES, ITEMS OF WORK, THOUGH NOT INDICATED BUT REQUIRED TO MAKE THE SYSTEM COMPLETE FOR ITS SAFE, EFFECIENT, RELIABLE AND TROUBLE FREE OPERATION AND MAINTENANCE SHALL ALSO BE INCLUDED IN BIDDER'S SCOPE UNLESS SPECIFICALLY EXCLUDED.

FOR TENDER PURPOSE ONLY

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	C.	M.	E.	C&I	APPD.	DATE
B	RELEASED FOR TENDER									
A	RELEASED FOR TENDER	PRIYANKA	MK							

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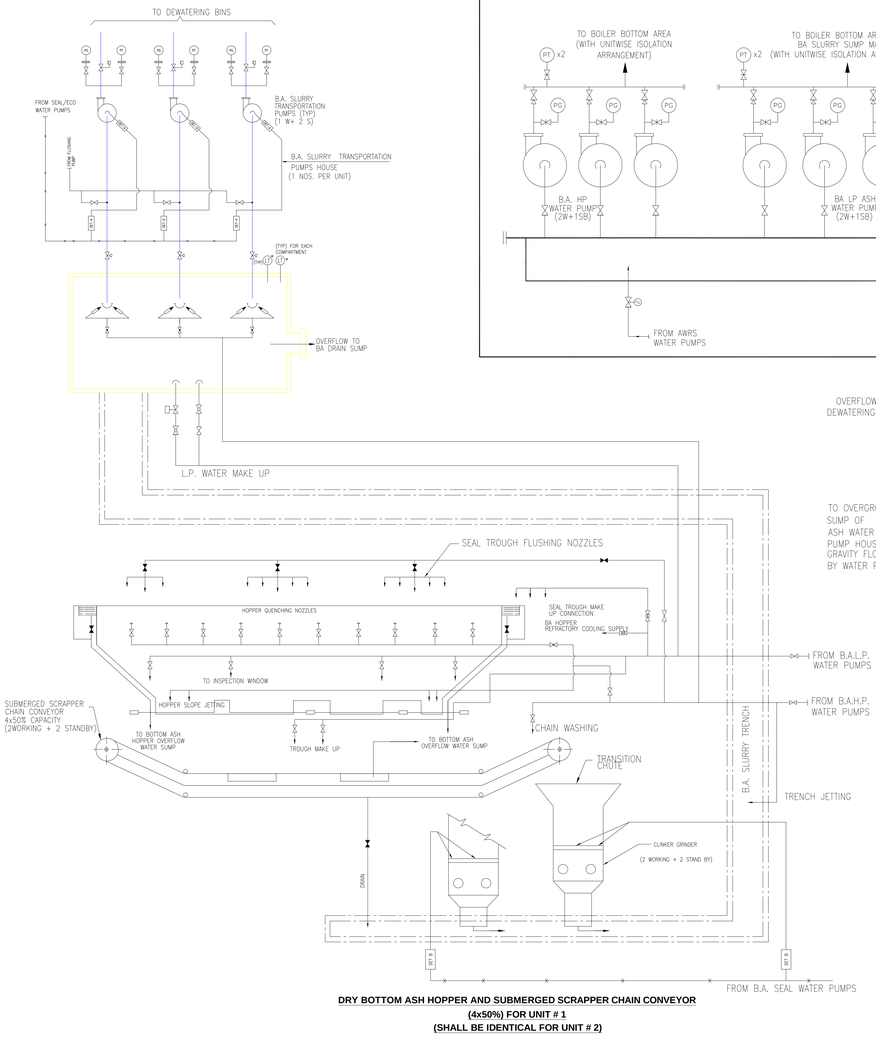
CONSULTANT: एन टी पी सी लिमिटेड NTPC Limited (A GOVT. OF INDIA ENTERPRISE) ENGINEERING DIVISION

PROJECT: LARA SUPER THERMAL POWER PROJECT
STAGE – II (2x800MW)
EPC PACKAGE

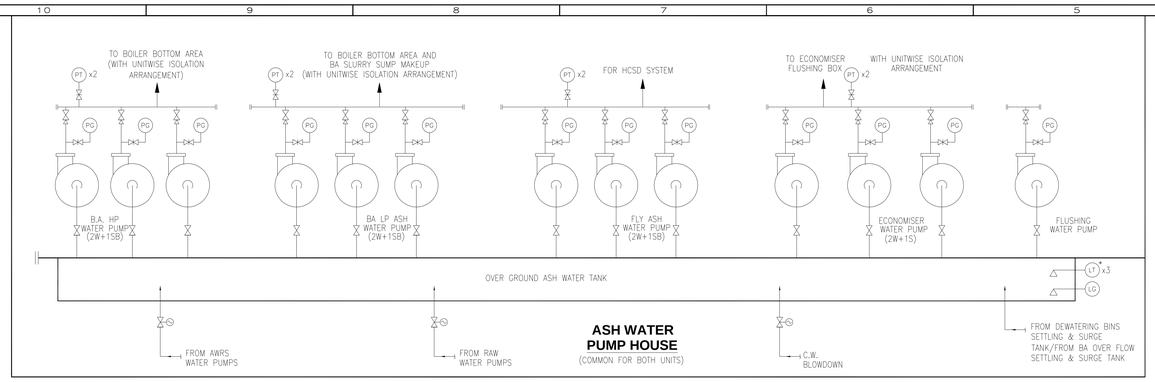
TITLE: SINGLE LINE FLOW DIAGRAM OF BOTTOM ASH HANDLING SYSTEM (JET PUMP SYSTEM) ASH DISPOSAL & ASH WATER SYSTEM

SIZE	SCALE	DRG.NO.	REV.
AO		9587-001(R)-POM-A-025	B

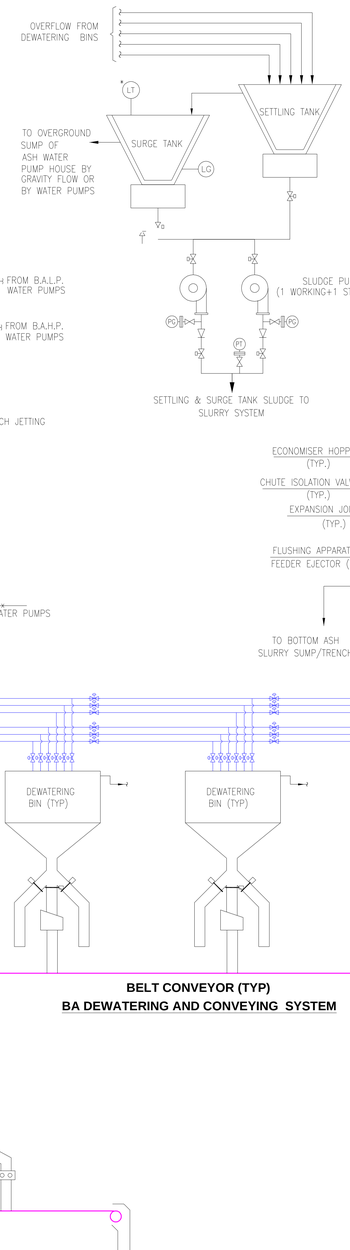
cad file name : 9587-001(R)-POM-A-025.dwg



DRY BOTTOM ASH HOPPER AND SUBMERGED SCRAPPER CHAIN CONVEYOR (4x50%) FOR UNIT # 1 (SHALL BE IDENTICAL FOR UNIT # 2)



ASH WATER PUMP HOUSE
(COMMON FOR BOTH UNITS)

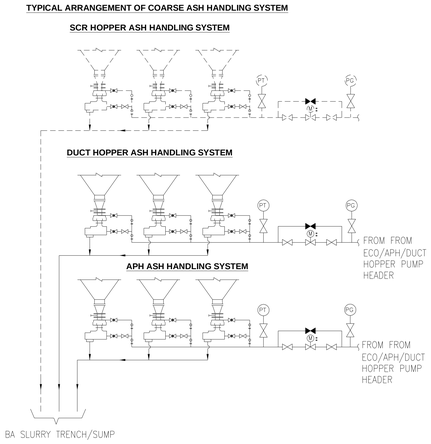


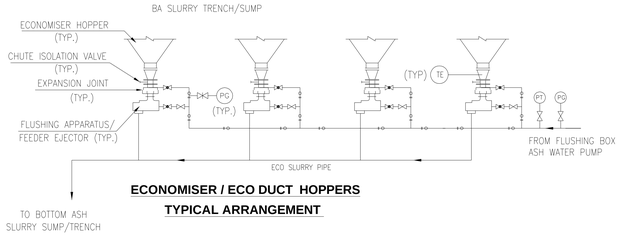
TYPICAL ARRANGEMENT OF COARSE ASH HANDLING SYSTEM

SCR HOPPER ASH HANDLING SYSTEM

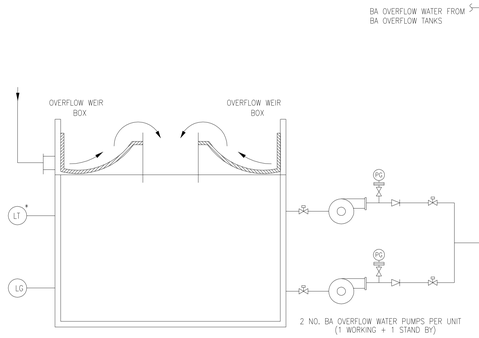
DUCT HOPPER ASH HANDLING SYSTEM

APH ASH HANDLING SYSTEM

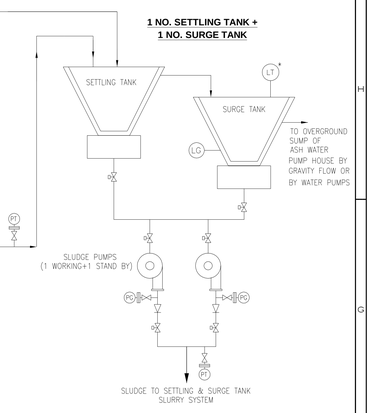


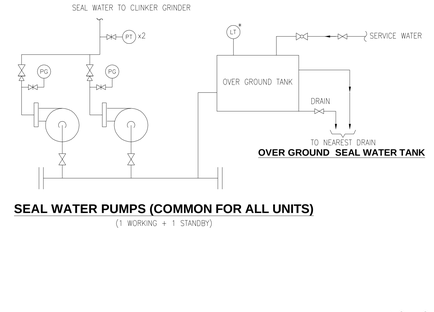


ECONOMISER / ECO DUCT HOPPERS
TYPICAL ARRANGEMENT



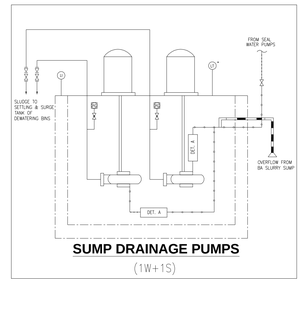
BA OVERFLOW WATER TANK





OVER GROUND SEAL WATER TANK

SEAL WATER PUMPS (COMMON FOR ALL UNITS)
(1 WORKING + 1 STANDBY)



SUMP DRAINAGE PUMPS
(1W+1S)

BELT CONVEYOR (TYP)
BA DEWATERING AND CONVEYING SYSTEM

BELT CONVEYOR (TYP)
BA DEWATERING AND CONVEYING SYSTEM

BELT CONVEYOR (TYP)
BA DEWATERING AND CONVEYING SYSTEM

LEGEND :

- PLUG VALVE
- GLOBE VALVE
- NON RETURN VALVE
- ISOLATION VALVE
- ISOLATION VALVE (PNEUMATICALLY OPERATED)
- RELIEF VALVE
- PUMP
- PS — PRESSURE SWITCH
- PG — PRESSURE GAUGE
- DPG — DIFFERENTIAL PRESSURE GUAGE
- STRAINER
- SOLENOID VALVE (PNEUMATICALLY OPERATED)
- MOTORISED VALVE
- ASH SLURRY VALVE
- PT — PRESSURE TRANSMITTER
- LT — LEVEL TRANSMITTER (ULTRASONIC TYPE)
- LG — LEVEL GAUGE
- INSTRUMENT VALVE
- DIAPHRAGM SEAL
- PNEUMATIC VALVE
- LG — LEVEL INDICATOR

NOTES

1. BOTTOM ASH / ECO ASH / APH ASH / SCR ASH / DUCT HOPPER ASH HANDLING SYSTEM SHOWN IS INDICATIVE. COMPLETE ASH HANDLING SYSTEM SHALL BE DESIGNED & SUPPLIED MEETING FUNCTIONAL REQUIREMENTS FOR BOTH UNITS.
2. THE SCHEME & NO. OF PUMPS/EQUIPMENT SHALL BE FINALISED BASED ON STIPULATIONS OF TECHNICAL SPECIFICATION & SYSTEM REQUIREMENTS.
3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH TECH.SPECS. AND OTHER TENDER DOCUMENTS. BIDDER MAY OPTIMIZE THE LAYOUT MEETING THE FUNCTIONAL AND TECHNICAL REQUIREMENTS.
4. INSTRUMENTS SHOWN ARE INDICATIVE ONLY. COMPLETE INSTRUMENTATION SHALL BE PROVIDED AS PER SYSTEM & FUNCTIONAL REQUIREMENTS SPECIFIED.
5. THE BOTTOM ASH HOPPER OVERFLOW WATER SHALL BE LED TO AN OVERFLOW TANK. BOTTOM ASH OVERFLOW WATER PUMP SHALL TAKE SUCTION FROM THIS OVERFLOW TANK AND PUMP THE WATER TO THE REQUIRED TREATMENT FACILITIES. SUITABLE CHEMICAL TREATMENT/ FILTRATION/ CLARIFICATION ETC. SHALL BE PROVIDED SO THAT TSS OF OUTLET WATER AT DISCHARGE OF SETTLING TANK/SURGE TANK SHALL NOT BE MORE THAN 100 PPM BEFORE THE WATER IS BEING DISCHARGED TO THE SUMP OF ASH WATER PUMP HOUSE.
6. THE ASH SLURRY PIPING FROM THE DISCHARGE OF BA SLURRY TRANSPORTATION PUMPS UP TO DEWATERING BINS SHALL BE BASALT LINED.
7. FOR MEETING THE FLUSHING APPARATUS WATER REQUIREMENT OF ECO HOPPERS, THREE(3) NOS. (TWO WORKING AND ONE STANDBY) ECONOMISER ASH WATER PUMPS ALONG WITH VALVES, PIPES & FITTINGS SHALL BE PROVIDED FOR ALL UNITS. THESE PUMPS SHALL BE LOCATED IN ASH WATER PUMP HOUSE.
8. FOR SEALING OF BA COOLING WATER OVERFLOW PUMPS, COOLING OF BA OVERFLOW PUMP FLUID COUPLING, SEALING OF CLINKER GRINDERS ETC, BIDDER SHALL PROVIDE TWO (2) NOS. (1 WORKING + 1 STANDBY) SEAL WATER PUMPS FOR ALL UNITS.
9. LIMIT SWITCHES ARE TO BE PROVIDED FOR MANUAL VALVES AS PER SYSTEM REQUIREMENTS & CONTROL PHILOSOPHY.
11. FOR ALL INSTRUMENTS AND DRIVES, SUPPLIER TO ASSIGN UNIQUE TAG NUMBERS FOR IDENTIFICATION. THIS TAG NUMBERS SHALL BE INDICATED ON DOCUMENTS/DRAWINGS/DATA SHEETS APPLICABLE FOR THE RESPECTIVE INSTRUMENT/DRIVE.
12. OVER FLOW FROM DEWATERING BINS SHALL BE TAKEN TO SETTLING TANK.SUITABLE CHEMICAL TREATMENT/ FILTRATION/ CLARIFICATION ETC. SHALL BE PROVIDED SO THAT TSS OF OUTLET WATER AT DISCHARGE OF SETTLING TANK/SURGE TANK SHALL NOT BE MORE THAN 100 PPM BEFORE THE WATER IS BEING DISCHARGED TO THE SUMP OF ASH WATER PUMP HOUSE.
13. RECIRCULATION LINE ALONG WITH VALVES AND INSTRUMENTATION IN ASH WATER PUMPS SHALL BE PROVIDED.
14. ALL ACCESSORIES, ITEMS OF WORK, THOUGH NOT INDICATED BUT REQUIRED TO MAKE THE SYSTEM COMPLETE FOR ITS SAFE, EFFECIENT, RELIABLE AND TROUBLE FREE OPERATION AND MAINTENANCE SHALL ALSO BE INCLUDED IN BIDDER'S SCOPE UNLESS SPECIFICALLY EXCLUDED.

FOR TENDER PURPOSE ONLY

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	C	M	E	C&I	APPD	DATE
B	RELEASED FOR TENDER	PRIYANKA	MR							
A	RELEASED FOR TENDER									

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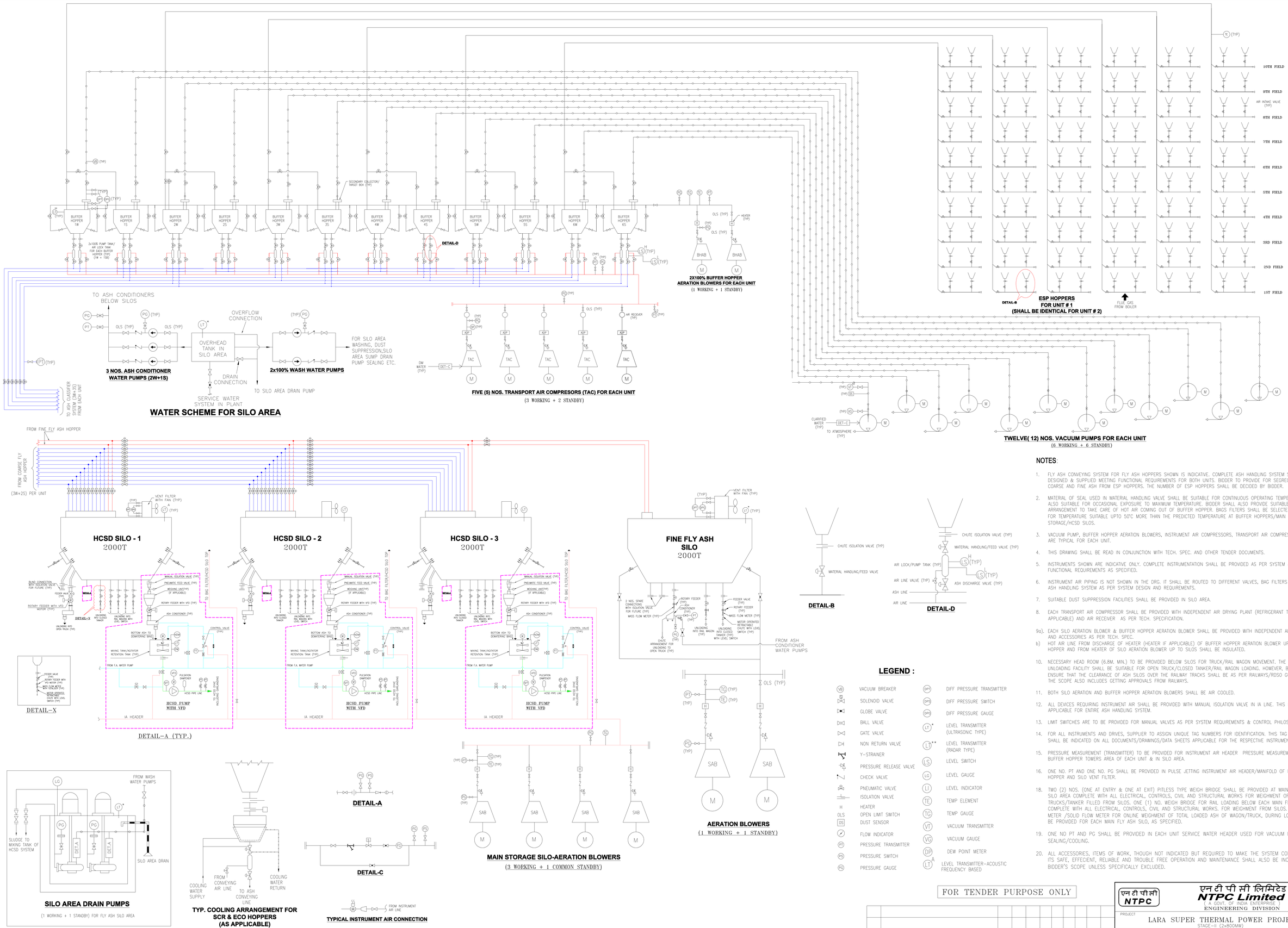
CONSULTANT: एन टी पी सी लिमिटेड NTPC Limited (A GOVT. OF INDIA ENTERPRISE) ENGINEERING DIVISION

PROJECT: LARA SUPER THERMAL POWER PROJECT
STAGE-II (2x800MW)

TITLE: ASH HANDLING SYSTEM
SINGLE LINE FLOW DIAGRAM OF BOTTOM ASH HANDLING SYSTEM (SUBMERGED SCRAPER CHAIN CONVEYOR) ASH DISPOSAL & ASH WATER SYSTEM)

SIZE: A0 | SCALE: | DRG.NO.: 9587-001(R)-POM-A-026 | REV.: B

cad file name : 9587-001(R)-POM-A-026.dwg



NOTES:

1. FLY ASH CONVEYING SYSTEM FOR FLY ASH HOPPERS SHOWN IS INDICATIVE. COMPLETE ASH HANDLING SYSTEM SHALL BE DESIGNED & SUPPLIED MEETING FUNCTIONAL REQUIREMENTS FOR BOTH UNITS. BIDDER TO PROVIDE FOR SEGREGATION OF COARSE AND FINE ASH FROM ESP HOPPERS, THE NUMBER OF ESP HOPPERS SHALL BE DECIDED BY BIDDER.
2. MATERIAL OF SEAL USED IN MATERIAL HANDLING VALVE SHALL BE SUITABLE FOR CONTINUOUS OPERATING TEMPERATURE AND ALSO SUITABLE FOR OCCASIONAL EXPOSURE TO MAXIMUM TEMPERATURE. BIDDER SHALL ALSO PROVIDE SUITABLE ARRANGEMENT TO TAKE CARE OF HOT AIR COMING OUT OF BUFFER HOPPER. BAGS FILTERS SHALL BE SELECTED SUITABLE FOR TEMPERATURE SUITABLE UPTO 50°C MORE THAN THE PREDICTED TEMPERATURE AT BUFFER HOPPERS/MAIN STORAGE/HCSD SILOS.
3. VACUUM PUMP, BUFFER HOPPER AERATION BLOWERS, INSTRUMENT AIR COMPRESSORS, TRANSPORT AIR COMPRESSORS SHOWN ARE TYPICAL FOR EACH UNIT.
4. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH TECH. SPEC. AND OTHER TENDER DOCUMENTS.
5. INSTRUMENTS SHOWN ARE INDICATIVE ONLY. COMPLETE INSTRUMENTATION SHALL BE PROVIDED AS PER SYSTEM & FUNCTIONAL REQUIREMENTS AS SPECIFIED.
6. INSTRUMENT AIR PIPING IS NOT SHOWN IN THE DRG. IT SHALL BE ROUTED TO DIFFERENT VALVES, BAG FILTERS ETC. IN FLY ASH HANDLING SYSTEM AS PER SYSTEM DESIGN AND REQUIREMENTS.
7. SUITABLE DUST SUPPRESSION FACILITIES SHALL BE PROVIDED IN SILO AREA.
8. EACH TRANSPORT AIR COMPRESSOR SHALL BE PROVIDED WITH INDEPENDENT AIR DRYING PLANT (REFRIGERANT TYPE, IF APPLICABLE) AND AIR RECEIVER AS PER TECH. SPECIFICATION.

9a). EACH SILO AERATION BLOWER & BUFFER HOPPER AERATION BLOWER SHALL BE PROVIDED WITH INDEPENDENT AIR HEATERS AND ACCESSORIES AS PER TECH. SPEC.

b) HOT AIR LINE FROM DISCHARGE OF HEATER (HEATER IF APPLICABLE) OF BUFFER HOPPER AERATION BLOWER UP TO BUFFER HOPPER AND FROM HEATER OF SILO AERATION BLOWER UP TO SILOS SHALL BE INSULATED.

10. NECESSARY HEAD ROOM (6.8M. MIN.) TO BE PROVIDED BELOW SILOS FOR TRUCK/RAIL WAGON MOVEMENT. THE SILO UNLOADING FACILITY SHALL BE SUITABLE FOR OPEN TRUCK/CLOSED TANKER/RAIL WAGON LOADING. HOWEVER, BIDDER SHALL ENSURE THAT THE CLEARANCE OF ASH SILOS OVER THE RAILWAY TRACKS SHALL BE AS PER RAILWAYS/RDSO GUIDELINES. THE SCOPE ALSO INCLUDES GETTING APPROVALS FROM RAILWAYS.
11. BOTH SILO AERATION AND BUFFER HOPPER AERATION BLOWERS SHALL BE AIR COOLED.
12. ALL DEVICES REQUIRING INSTRUMENT AIR SHALL BE PROVIDED WITH MANUAL ISOLATION VALVE IN IA LINE. THIS IS APPLICABLE FOR ENTIRE ASH HANDLING SYSTEM.
13. LIMIT SWITCHES ARE TO BE PROVIDED FOR MANUAL VALVES AS PER SYSTEM REQUIREMENTS & CONTROL PHILOSOPHY.
14. FOR ALL INSTRUMENTS AND DRIVES, SUPPLIER TO ASSIGN UNIQUE TAG NUMBERS FOR IDENTIFICATION. THIS TAG NUMBER SHALL BE INDICATED ON ALL DOCUMENTS/DRAWINGS/DATA SHEETS APPLICABLE FOR THE RESPECTIVE INSTRUMENT/DRIVE.
15. PRESSURE MEASUREMENT (TRANSMITTER) TO BE PROVIDED FOR INSTRUMENT AIR HEADER PRESSURE MEASUREMENT AT BUFFER HOPPER TOWERS AREA OF EACH UNIT & IN SILO AREA.
16. ONE NO. PT AND ONE NO. PG SHALL BE PROVIDED IN PULSE JETTING INSTRUMENT AIR HEADER/MANIFOLD OF EACH BUFFER HOPPER AND SILO VENT FILTER.
18. TWO (2) NOS. (ONE AT ENTRY & ONE AT EXIT) PITLESS TYPE WEIGH BRIDGE SHALL BE PROVIDED AT MAIN FLY ASH SILO AREA COMPLETE WITH ALL ELECTRICAL, CONTROLS, CIVIL AND STRUCTURAL WORKS FOR WEIGHMENT OF TRUCKS/TANKER FILLED FROM SILOS. ONE (1) NO. WEIGH BRIDGE FOR RAIL LOADING BELOW EACH MAIN FLY ASH SILO COMPLETE WITH ALL ELECTRICAL, CONTROLS, CIVIL AND STRUCTURAL WORKS. FOR WEIGHMENT FROM SILOS. MASS FLOW METER /SOLID FLOW METER FOR ONLINE WEIGHMENT OF TOTAL LOADED ASH OF WAGON/TRUCK, DURING LOADING SHALL BE PROVIDED FOR EACH MAIN FLY ASH SILO, AS SPECIFIED.
19. ONE NO PT AND PG SHALL BE PROVIDED IN EACH UNIT SERVICE WATER HEADER USED FOR VACUUM PUMP SEALING/COOLING.
20. ALL ACCESSORIES, ITEMS OF WORK, THOUGH NOT INDICATED BUT REQUIRED TO MAKE THE SYSTEM COMPLETE FOR ITS SAFE, EFFECIENT, RELIABLE AND TROUBLE FREE OPERATION AND MAINTENANCE SHALL ALSO BE INCLUDED IN BIDDER'S SCOPE UNLESS SPECIFICALLY EXCLUDED.

LEGEND :

VB	VACUUM BREAKER	DPT	DIFF PRESSURE TRANSMITTER
	SOLENOID VALVE	DPS	DIFF PRESSURE SWITCH
	GLOBE VALVE	DPG	DIFF PRESSURE GAUGE
	BALL VALVE	LT*	LEVEL TRANSMITTER (ULTRASONIC TYPE)
	GATE VALVE	LT**	LEVEL TRANSMITTER (RADAR TYPE)
	NON RETURN VALVE	LS	LEVEL SWITCH
	Y-STRAINER	LG	LEVEL GAUGE
	PRESSURE RELEASE VALVE	LI	LEVEL INDICATOR
	CHECK VALVE	TE	TEMP ELEMENT
	PNEUMATIC VALVE	TG	TEMP GAUGE
	ISOLATION VALVE	VT	VACUUM TRANSMITTER
H	HEATER	VG	VACUUM GAUGE
OLS	OPEN LIMIT SWITCH	DP	DEW POINT METER
DS	DUST SENSOR	LT A	LEVEL TRANSMITTER–ACOUSTIC FREQUENCY BASED
	FLOW INDICATOR		
PT	PRESSURE TRANSMITTER		
PS	PRESSURE SWITCH		
PG	PRESSURE GAUGE		

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REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	C	M	E	C&I	APPD	DATE
					CLEARED BY					
B	RELEASED FOR TENDER	DEVDAS	MK							
A	RELEASED FOR TENDER									

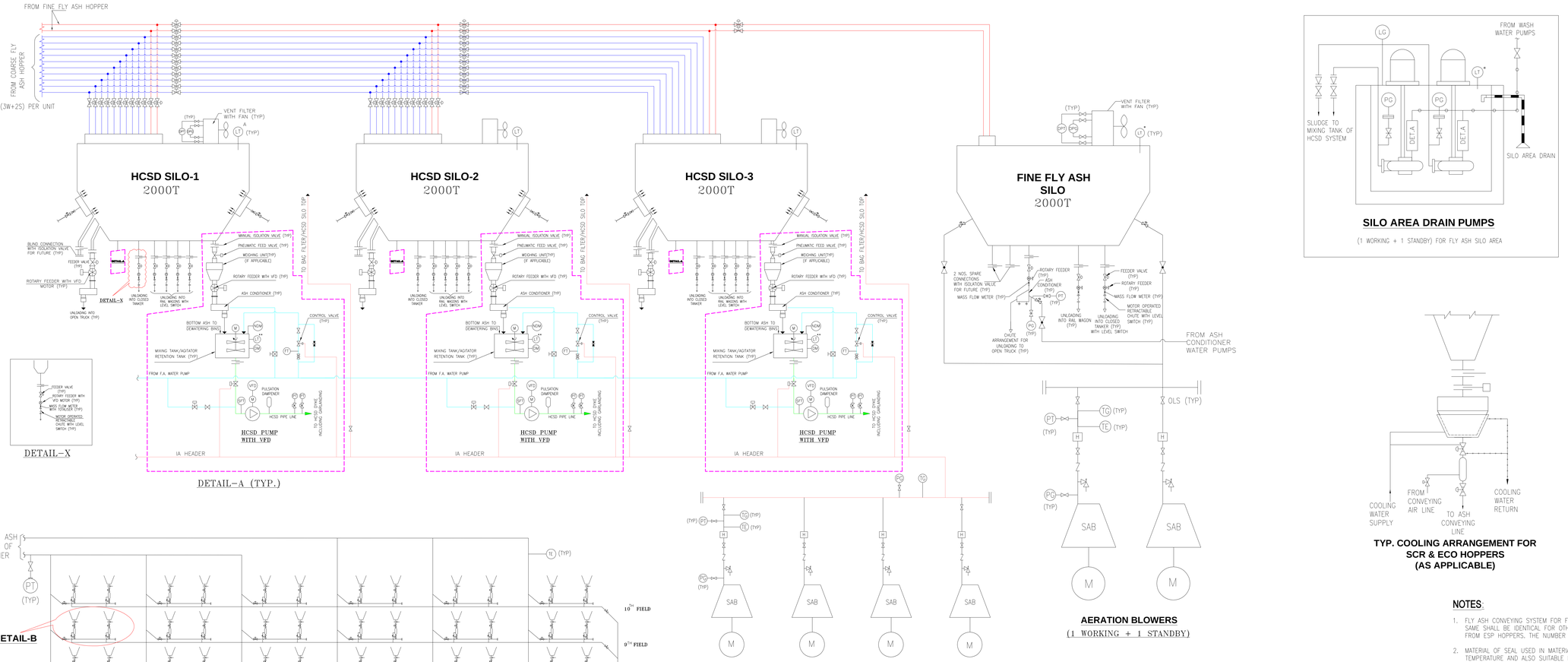
एन टी पी सी लिमिटेड
NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: LARA SUPER THERMAL POWER PROJECT
STAGE-II (2x800MW)
EPC PACKAGE

TITLE: SINGLE LINE FLOW DIAGRAM FOR FLY ASH HANDLING SYSTEM (VACUUM SYSTEM) (APPLICABLE FOR ESP HOPPERS)

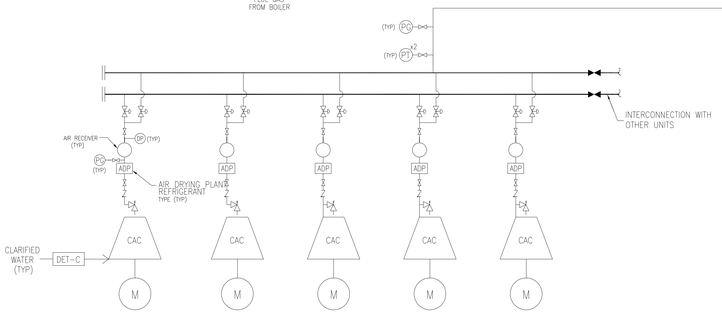
SIZE	SCALE	DRG.NO.	REV.
A0	---	9587-001(R)-POM-A-027	B

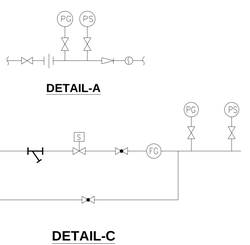
cad file name : 9587-001(R)-POM-A-027.dwg

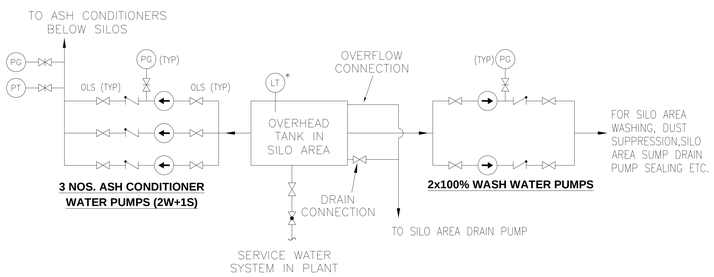


LEGEND :

VB	VACUUM BREAKER
	SOLENOID VALVE
	GLOBE VALVE
	BALL VALVE
	GATE VALVE
	NON RETURN VALVE
	Y-STRAINER
	PRESSURE RELEASE VALVE
	CHECK VALVE
	PNEUMATIC VALVE
	ISOLATION VALVE
	ISOLATION VALVE (CYL. OP.)
H	HEATER
OLS	OPEN LIMIT SWITCH
DS	DUST SENSOR
	FLOW INDICATOR
PT	PRESSURE TRANSMITTER
PS	PRESSURE SWITCH
PG	PRESSURE GAUGE
SFT	SLURRY FLOW TRANSMITTER
NDM	NUCLEONIC DENSITY METER
DM	DENSITY METER (CORIOLIS TYPE)
M	MOTOR
VFD	VARIABLE FREQUENCY DRIVE
DPT	DIFF PRESSURE TRANSMITTER
DPS	DIFF PRESSURE SWITCH
DPG	DIFF PRESSURE GAUGE
LT*	LEVEL TRANSMITTER (ULTRASONIC TYPE)
LT**	LEVEL TRANSMITTER (RADAR TYPE)
LS	LEVEL SWITCH
LG	LEVEL GAUGE
LI	LEVEL INDICATOR
TE	TEMP ELEMENT
TG	TEMP GAUGE
VT	VACUUM TRANSMITTER
VG	VACUUM GAUGE
DP	DEW POINT METER
LT A	LEVEL TRANSMITTER-ACOUSTIC FREQUENCY BASED
FT	FLOW TRANSMITTER







NOTES:

1. FLY ASH CONVEYING SYSTEM FOR FLY ASH HOPPERS SHOWN IS INDICATIVE AND IS FOR ONE UNIT ONLY AND THE SAME SHALL BE IDENTICAL FOR OTHER UNIT. BIDDER TO PROVIDE FOR SEGREGATION OF COARSE AND FINE ASH FROM ESP HOPPERS, THE NUMBER OF ESP HOPPERS SHALL BE DECIDED BY BIDDER.
2. MATERIAL OF SEAL USED IN MATERIAL HANDLING VALVE SHALL BE SUITABLE FOR CONTINUOUS OPERATING TEMPERATURE AND ALSO SUITABLE FOR OCCASIONAL EXPOSURE TO MAXIMUM TEMPERATURE. BIDDER SHALL ALSO PROVIDE SUITABLE ARRANGEMENT TO TAKE CARE OF HOT AIR COMING OUT OF BUFFER HOPPER. BAGS FILTERS SHALL BE SELECTED SUITABLE FOR TEMPERATURE SUITABLE UPTO 50°C MORE THAN THE PREDICTED TEMPERATURE AT BUFFER HOPPERS/MAIN STORAGE/HSHD SILOS.
3. CONVEYING AIR COMPRESSORS & INSTRUMENT AIR COMPRESSORS SHOWN ARE TYPICAL FOR EACH UNIT. TRANSPORT AIR COMPRESSORS SHOWN ARE FOR BOTH UNITS
4. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH TECH. SPEC. AND OTHER TENDER DOCUMENTS.
5. INSTRUMENTS SHOWN ARE INDICATIVE ONLY. COMPLETE INSTRUMENTATION SHALL BE PROVIDED AS PER SYSTEM & FUNCTIONAL REQUIREMENTS AS SPECIFIED.
6. INSTRUMENT AIR PIPING IS NOT SHOWN IN THE DRG. IT SHALL BE ROUTED TO DIFFERENT VALVES, BAG FILTERS ETC. IN FLY ASH HANDLING SYSTEM AS PER SYSTEM DESIGN AND REQUIREMENTS.
7. SUITABLE DUST SUPPRESSION FACILITIES SHALL BE PROVIDED IN SILO AREA.
8. EACH TRANSPORT AIR COMPRESSOR AND CONVEYING AIR COMPRESSOR SHALL BE PROVIDED WITH INDEPENDENT AIR DRYING PLANT (REFRIGERANT TYPE, IF APPLICABLE) AND AIR RECEIVER AS PER TECH. SPECIFICATION.

9a). EACH SILO AERATION BLOWER & BUFFER HOPPER AERATION BLOWER SHALL BE PROVIDED WITH INDEPENDENT AIR HEATERS AND ACCESSORIES AS PER TECH. SPEC.
b) HOT AIR LINE FROM DISCHARGE OF HEATER (HEATER IF APPLICABLE) OF SILO AERATION BLOWER UP TO SILOS SHALL BE INSULATED.

10. NECESSARY HEAD ROOM (6.8M. MIN.) TO BE PROVIDED BELOW SILOS FOR TRUCK/RAIL WAGON MOVEMENT. THE SILO UNLOADING FACILITY SHALL BE SUITABLE FOR OPEN TRUCK/CLOSED TANKER/RAIL WAGON LOADING. HOWEVER, BIDDER SHALL ENSURE THAT THE CLEARANCE OF ASH SILOS OVER THE RAILWAY TRACKS SHALL BE AS PER RAILWAYS/RDSO GUIDELINES. THE SCOPE ALSO INCLUDES GETTING APPROVALS FROM RAILWAYS.
11. BOTH SILO AERATION AND BUFFER HOPPER AERATION BLOWERS SHALL BE AIR COOLED.
12. ALL DEVICES REQUIRING INSTRUMENT AIR SHALL BE PROVIDED WITH MANUAL ISOLATION VALVE IN IA LINE. THIS IS APPLICABLE FOR ENTIRE ASH HANDLING SYSTEM.
13. LIMIT SWITCHES ARE TO BE PROVIDED FOR MANUAL VALVES AS PER SYSTEM REQUIREMENTS & CONTROL PHILOSOPHY.
14. FOR ALL INSTRUMENTS AND DRIVES, SUPPLIER TO ASSIGN UNIQUE TAG NUMBERS FOR IDENTIFICATION. THIS TAG NUMBER SHALL BE INDICATED ON ALL DOCUMENTS/DRAWINGS/DATA SHEETS APPLICABLE FOR THE RESPECTIVE INSTRUMENT/DRIVE.
15. PRESSURE MEASUREMENT (TRANSMITTER) TO BE PROVIDED FOR INSTRUMENT AIR HEADER PRESSURE MEASUREMENT IN SILO AREA.
16. ONE NO. PT AND ONE NO. PG SHALL BE PROVIDED IN PULSE JETTING INSTRUMENT AIR HEADER/MANIFOLD OF SILO VENT FILTER.
17. BIDDER TO FURNISH ALL INSTRUMENTS/CONTROLS AS PER SYSTEM REQUIREMENT. INSTRUMENT AND CONTROLS FOR AUTOMATIC OPERATION OF PUMPS & EQUIPMENTS ARE NOT SHOWN FOR CLARITY IN THIS DRG. THE SAME SHALL BE PROVIDED AS PER SYSTEM REQUIREMENT AND AS SPECIFIED IN TECH. SPECIFICATION.
18. TWO (2) NOS. (ONE AT ENTRY & ONE AT EXIT) PITLESS TYPE WEIGH BRIDGE SHALL BE PROVIDED AT MAIN FLY ASH SILO AREA COMPLETE WITH ALL ELECTRICAL, CONTROLS, CIVIL AND STRUCTURAL WORKS FOR WEIGHMENT OF TRUCKS/TANKER FILLED FROM SILOS. ONE (1) NO. WEIGH BRIDGE FOR RAIL LOADING BELOW EACH MAIN FLY ASH SILO COMPLETE WITH ALL ELECTRICAL, CONTROLS, CIVIL AND STRUCTURAL WORKS. FOR WEIGHMENT FROM SILOS. MASS FLOW METER /SOLID FLOW METER FOR ONLINE WEIGHMENT OF TOTAL LOADED ASH OF WAGON/TRUCK, DURING LOADING SHALL BE PROVIDED FOR EACH MAIN FLY ASH SILO, AS SPECIFIED.
19. REFER CLAUSE NO 1.01.06 (B) OF PART –A OF TECHNICAL SPEC
20. ALL ACCESSORIES, ITEMS OF WORK, THOUGH NOT INDICATED BUT REQUIRED TO MAKE THE SYSTEM COMPLETE FOR ITS SAFE, EFFECIENT, RELIABLE AND TROUBLE FREE OPERATION AND MAINTENANCE SHALL ALSO BE INCLUDED IN BIDDER'S SCOPE UNLESS SPECIFICALLY EXCLUDED.

FOR TENDER PURPOSE ONLY

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	C	M	E	C&I	APPD	DATE
B	RELEASED FOR TENDER									
A	RELEASED FOR TENDER	Priyanka	MK							

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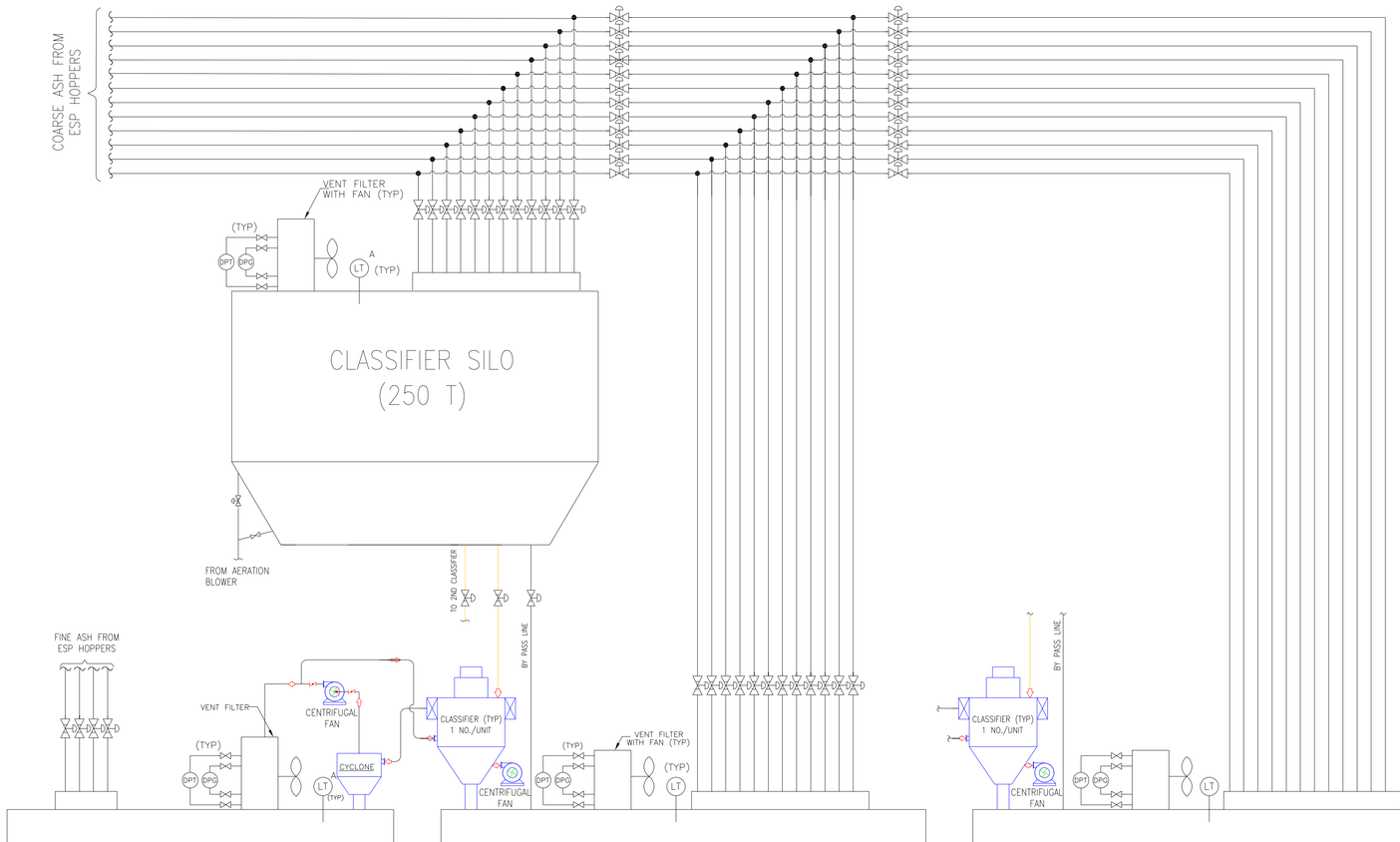
NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: LARA SUPER THERMAL POWER PROJECT
STAGE-II (2×800MW)

TITLE: EPC PACKAGE
SINGLE LINE FLOW DIAGRAM FOR FLY ASH HANDLING SYSTEM (PRESSURE SYSTEM)

SIZE	SCALE	DRG.NO.	REV.
A0	- - -	9587-001(R)-POM-A-028	B

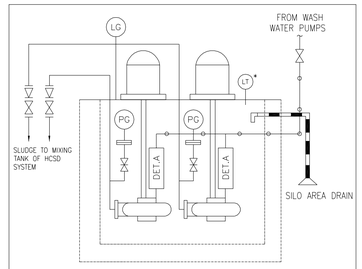
cad file name : 9587-001(R)-POM-A-028.dwg



AERATION BLOWERS
(2 WORKING + 1 STANDBY)

(3 WORKING + 2 STANDBY)
FIVE (5) NOS. TRANSPORT AIR COMPRESORS (TAC)

(3 WORKING + 2 STANDBY)
FIVE (5) NOS. TRANSPORT AIR COMPRESORS (TAC)



DRAIN PUMPS
(1 WORKING + 1 STANDBY)

NOTES

1. ASH CLASSIFIER SYSTEM SHOWN IS INDICATIVE ONLY. ASH CLASSIFIER SYSTEM SHALL BE DESIGNED & SUPPLIED MEETING FUNCTIONAL REQUIREMENTS FOR BOTH UNITS.
2. THE SCHEME & NO. OF EQUIPMENT SHALL BE FINALISED BASED ON STIPULATIONS OF TECHNICAL SPECIFICATION & SYSTEM REQUIREMENTS.
3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH TECH.SPECS. AND OTHER TENDER DOCUMENTS. BIDDER MAY OPTIMIZE THE LAYOUT MEETING THE FUNCTIONAL AND TECHNICAL REQUIREMENTS.
4. INSTRUMENTS SHOWN ARE INDICATIVE ONLY. COMPLETE INSTRUMENTATION SHALL BE PROVIDED AS PER SYSTEM & FUNCTIONAL REQUIREMENTS SPECIFIED.
5. LIMIT SWITCHES ARE TO BE PROVIDED FOR MANUAL VALVES AS PER SYSTEM REQUIREMENTS & CONTROL PHILOSOPHY.
6. FOR ALL INSTRUMENTS AND DRIVES, SUPPLIER TO ASSIGN UNIQUE TAG NUMBERS FOR IDENTIFICATION. THIS TAG NUMBERS SHALL BE INDICATED ON DOCUMENTS/DRAWINGS/DATA SHEETS APPLICABLE FOR THE RESPECTIVE INSTRUMENT/DRIVE.
7. THIS OPTION IS APPLICABLE FOR SYSTEM WHERE ESP BUFFER HOPPER IS NOT ENVISAGED.
8. ALL ACCESSORIES, ITEMS OF WORK, THOUGH NOT INDICATED BUT REQUIRED TO MAKE THE SYSTEM COMPLETE FOR ITS SAFE, EFFECIENT, RELIABLE AND TROUBLE FREE OPERATION AND MAINTENANCE SHALL ALSO BE INCLUDED IN BIDDER'S SCOPE UNLESS SPECIFICALLY EXCLUDED.

FOR TENDER PURPOSE ONLY

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	C	M	E	C&I	APPD	DATE
B	RELEASED FOR TENDER									
A	RELEASED FOR TENDER	Priyanka	MK							

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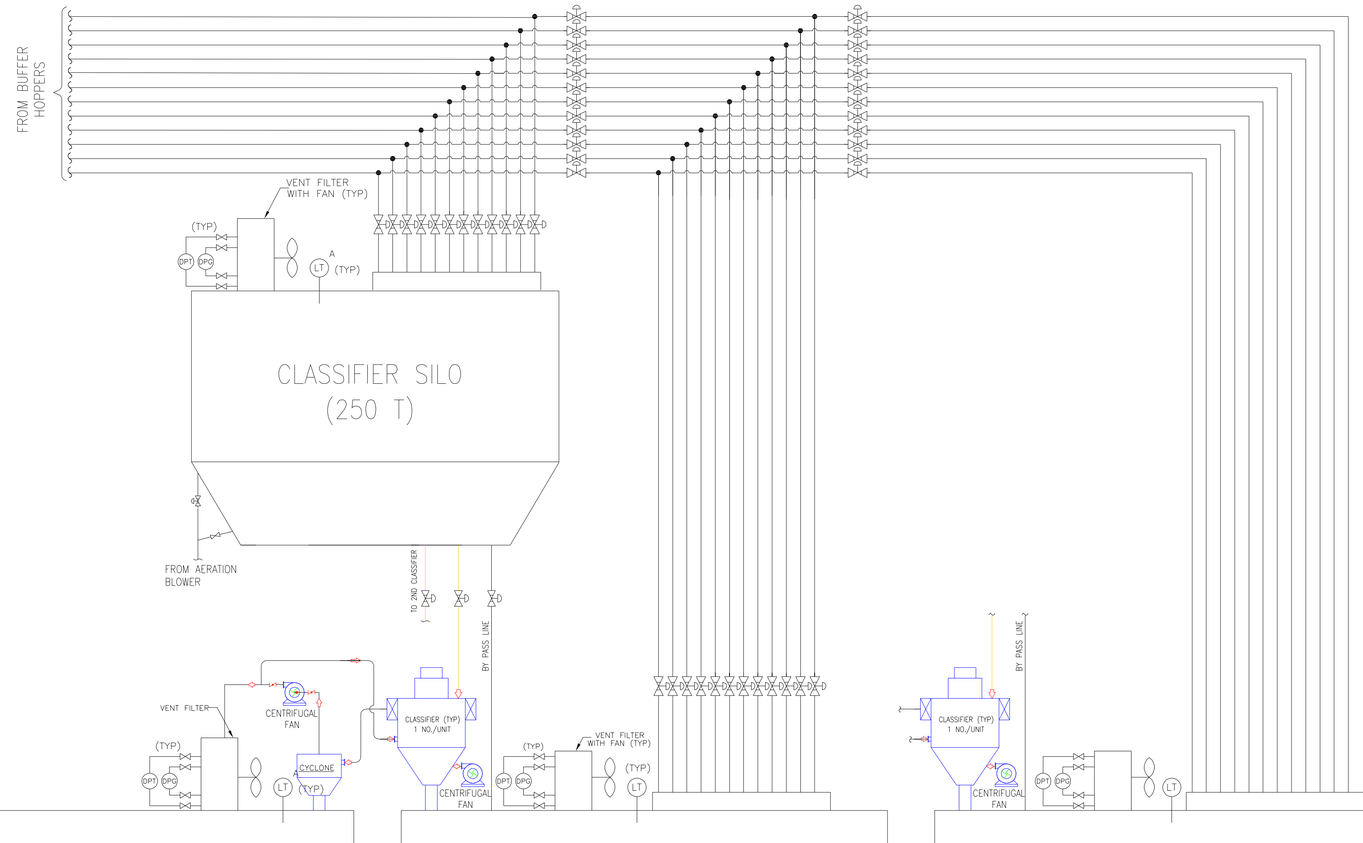
NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION

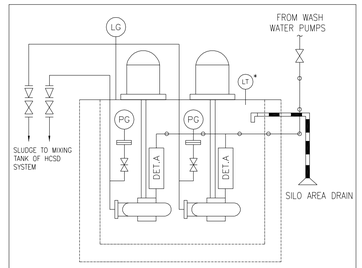
PROJECT: **LARA SUPER THERMAL POWER PROJECT**
STAGE-II(2x800MW)

TITLE: EPC PACKAGE
SINGLE LINE DIAGRAM FOR ASH CLASSIFIER SYSTEM (PRESSURE SYSTEM)

SIZE	SCALE	DRG.NO.	REV.
A1	--	**9587-001(R)-POM-A-029**	B

CAD FILE NAME : 9587-001(R)-POM-A-029.dwg





DRAIN PUMPS
(1 WORKING + 1 STANDBY)

NOTES

1. ASH CLASSIFIER SYSTEM SHOWN IS INDICATIVE ONLY. ASH CLASSIFIER SYSTEM SHALL BE DESIGNED & SUPPLIED MEETING FUNCTIONAL REQUIREMENTS FOR BOTH UNITS.
2. THE SCHEME & NO. OF EQUIPMENT SHALL BE FINALISED BASED ON STIPULATIONS OF TECHNICAL SPECIFICATION & SYSTEM REQUIREMENTS.
3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH TECH.SPECS. AND OTHER TENDER DOCUMENTS. BIDDER MAY OPTIMIZE THE LAYOUT MEETING THE FUNCTIONAL AND TECHNICAL REQUIREMENTS.
4. INSTRUMENTS SHOWN ARE INDICATIVE ONLY. COMPLETE INSTRUMENTATION SHALL BE PROVIDED AS PER SYSTEM & FUNCTIONAL REQUIREMENTS SPECIFIED.
5. LIMIT SWITCHES ARE TO BE PROVIDED FOR MANUAL VALVES AS PER SYSTEM REQUIREMENTS & CONTROL PHILOSOPHY.
6. FOR ALL INSTRUMENTS AND DRIVES, SUPPLIER TO ASSIGN UNIQUE TAG NUMBERS FOR IDENTIFICATION. THIS TAG NUMBERS SHALL BE INDICATED ON DOCUMENTS/DRAWINGS/DATA SHEETS APPLICABLE FOR THE RESPECTIVE INSTRUMENT/DRIVE.
7. THIS OPTION IS APPLICABLE FOR SYSTEM WHERE ESP BUFFER HOPPER IS ENVISAGED.
8. ALL ACCESSORIES, ITEMS OF WORK, THOUGH NOT INDICATED BUT REQUIRED TO MAKE THE SYSTEM COMPLETE FOR ITS SAFE, EFFECIENT, RELIABLE AND TROUBLE FREE OPERATION AND MAINTENANCE SHALL ALSO BE INCLUDED IN BIDDER'S SCOPE UNLESS SPECIFICALLY EXCLUDED.

FOR TENDER PURPOSE ONLY

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	C	M	E	C&I	APPD	DATE
B	RELEASED FOR TENDER									
A	RELEASED FOR TENDER	Priyanka	MK							

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NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: **LARA SUPER THERMAL POWER PROJECT**
STAGE–II(2x800MW)

TITLE: EPC PACKAGE
SINGLE LINE DIAGRAM FOR ASH CLASSIFIER SYSTEM (VACUUM SYSTEM)

SIZE	SCALE	DRG.NO.	REV.
A1	––	**9587-001(R)-POM-A-029**	B

CAD FILE NAME : 9587–001(R)–POM–A–029.dwg

EPC PACKAGE FOR LARA SUPER THERMAL POWER PROJECT, STAGE-II (2x800 MW)
Amendment No. 02 to Technical Specifications Section-VI of Bidding Document No.: CS-9587-001R-2

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Section / Part	Sub-Section	Clause No.	Page No.		
C&I-1-01.	Vi/A	Mandatory spares(SUB-SECTION-VI CHAPTER-02 STEAM TURBINE GENERATOR)	**1.00.00(7) ANALYSERS**	**29/31**	6 Turbidity analysers (including sensing unit, Electronic Transmitter unit, prefabricated cable with connector as minimum) (if applicable) 1 Set of each type	Deleted
C&I-1-02.	Vi/A	IIC	12.02.00	**16/18**	-	*New clause added* Common IP based network for IP based PA system and IP based CCTV system involving common components viz. network switches, network media and power supplies may be acceptable subject to employer's approval during detail engineering.
C&I-1-03.	Vi/A	Annexure C to IIC part A	**A(2.04.09)**	**6/25**	-	*New clause added*: 2.04.09 **CT Process Block**: CT fans of both unit.
C&I-1-04.	Vi/A	SUB-SECTION-IIC3	SUB-SECTION-IIC3.03.00	11 of 18	Water Balance Dashboard Suitable displays/dash boards are to be generated in WS DDCMIS for indicating total water consumption of the plant and for indicating further **break down of this total water consumption into consumption of various plant areas**. **Additional flow measurements (**other than those indicated in the tender P&IDs/water balance diagram), if any required, for achieving the above	Water Balance Dashboard Suitable displays/dash boards are to be generated in WS DDCMIS for indicating total water consumption of the plant and for indicating further **break down of this total water consumption into consumption of various plant areas**.

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Section / Part	Sub-Section	Clause No.	Page No.		
					functionality shall also be in the scope of the Contractor	
C&I-1-05.	Vi/A	SUB-SECTION-VI CHAPTER -01 SG & AUXILIARIES(mandatory spares)	2.02.00	25/38	c) Analyser for De-NOX/ SCR system (Dust monitor, Ammonia Slip analyser, NOx analyser etc.)	Deleted
C&I-1-06.	Vi/A	Annexure C to IIC part-A	A (2.04.07)	**5/25**	**Air Compressor Block and NH3 handling System Block** This block shall include air Air compressor for Mill reject system. ……This block shall also include control of NH3 unloading, storage, transfer and heating system etc.	**Air Compressor Block and NH3 handling System Block:** This block shall include ***Air compressors(IAC/PAC),*** ~~Air compressor for Mill reject system~~. ……This block shall also include control of NH3 unloading, storage, transfer and heating system etc.
C&I-1-07.	Vi/A	Annexure C to IIC part-A	**A (2.10.00)**	**7/25**	**Make up Water System DDCMIS** This system has one process block for Make-up water.	**Make up Water System DDCMIS** This system has one process block for **Make-up water & Intake Water pumps.**

EPC PACKAGE FOR LARA SUPER THERMAL POWER PROJECT, STAGE-II (2x800 MW)
Amendment No. 02 to Technical Specifications Section-VI of Bidding Document No.: CS-9587-001R-2

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<tr><th>Section / Part</th><th>Sub-Section</th><th>Clause No.</th><th>Page No.</th><th></th><th></th></tr>
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<tr><td>1</td><td>Make Up Water Pump House</td><td>02 (see note 3 below)</td></tr>
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<tr><td>SN</td><td>Locations</td><td>No. of Cameras</td></tr>
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EPC PACKAGE FOR LARA SUPER THERMAL POWER PROJECT, STAGE-II (2x800 MW)
Amendment No. 02 to Technical Specifications Section-VI of Bidding Document No.: CS-9587-001R-2

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	SEC/PART	Sub-Section	Clause No.	Page No.		
Elec1-01	VI/PART-B	B-04: TRANSFORMERS AND ASSOCIATED MAINTENANCE, MONITORING & TESTING EQUIPMENTS, CL. NO: 1.05.01,B, PG NO. 7 OF 36			ST: The 2 x 100%, centrifugal or axial in line oil pumps (out of which one pump shall be standby) shall be provided with each radiator bank. Measures shall be taken to prevent maloperation of Buchholz relay when both oil pumps are simultaneously put into service. The pump shall be so designed that upon failure of power of supply to the pump motor, the pump impeller will not limit the natural circulation of oil. An oil flow indicator shall be provided for the confirmation of the oil pump operating in a normal state. An indication shall be provided in the flow indicator reverse flow of oil/loss of oil flow.	" ST **(above 130 MVA):** The 2 x 100%, centrifugal or axial in line oil pumps (out of which one pump shall be standby) shall be provided (if OFAF cooling is applicable to ST) with each radiator bank. Measures shall be taken to prevent maloperation of Buchholz relay when both oil pumps are simultaneously put into service. The pump shall be so designed that upon failure of power of supply to the pump motor, the pump impeller will not limit the natural circulation of oil. An oil flow indicator shall be provided for the confirmation of the oil pump operating in a normal state. An indication shall be provided in the flow indicator reverse flow of oil/loss of oil flow. "
Elec1-02	VI/PART-B	SUB SECTION B-06 LT SWITCHGEARS & LT BUSDUCTS, CLAUSE NO. 3.11.00 , PAGE 13 OF 19			Wireless temperature monitoring system to be provided and same shall be integrated to DDCMIS/ separate HMI. Temperature sensors shall be installed in all relevant joints, contact joints etc. as per the standard OEM Practice, however Position of such sensors shall be decided at the time of detailed engineering.	Wireless temperature monitoring system to be provided and same shall be integrated to DDCMIS/ separate HMI. Temperature sensors shall be installed in all relevant joints, contact joints etc. as per the standard OEM Practice, however Position of such sensors shall be decided at the time of detailed engineering. This shall be provided for the following switchgears: USS, BMCC, TMCC and EMCC

EPC PACKAGE FOR LARA SUPER THERMAL POWER PROJECT, STAGE-II (2x800 MW)
Amendment No. 02 to Technical Specifications Section-VI of Bidding Document No.: CS-9587-001R-2

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	SEC/PART	Sub-Section	Clause No.	Page No.		
Elec1-03	VI/PART-A	SUB SECTION-IIB – ELECTRICAL EQUIPMENTS/SYSTEMS CLAUSE NO. 1.16.08 PAGE 13 OF 20.			Any necessary protection/modifications required in the plant for mitigation of unwanted effects evident through the above study for safety of the plant equipments shall also be in bidder's scope.	**Any necessary protection/modifications in relay settings required in the plant for mitigation of unwanted effects evident through the above study for safety of the plant equipments shall also be in bidder's scope.**
Elec1-04	VI/PART-A	SUB SECTION-IIB – ELECTRICAL EQUIPMENTS/SYSTEMS CLAUSE NO. 1.16.06 PAGE 13 OF 20				Dismantling or rerouting of any EHV/HT/LT Lines passing through Lara-II Power plant area including boundary or anything else if required for preparing transmission corridor shall be in Bidder's scope. construction of new line take off gantries for raigarh kotra line 1 and 2 in existing stage 1 switchyard area shall be in bidders scope. Further bidder shall also dismantle existing line side equipments as required for placement of gantry/BPI etc. Bidder shall provide all necessary technical data/models and carryout all necessary studies (in PSS/E) as indicated in **"Formats of Technical Data for connectivity Agreement-**

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	SEC/PART	Sub-Section	Clause No.	Page No.		
						FORMAT-CON-TD-2" applicable for Thermal Power plants. Study results along with original files in PSS/E Format shall also be submitted by the bidder to the Employer.
Elec1-05	VI/PART-B	**SUBSECTION B-05(B) MV& LV SWGR-PROTECTIONS, CONTROL & METERING, CLAUSE NO: 3.03.12, PAGE 4 of 10.**			All motor feeders shall have 4-20mA analog output (current signal) for use in control logics in DDCMIS or for information in DDCMIS.	All motor feeders(>30KW) shall have min one no. of 4-20mA analog output (current signal) for use in control logics in DDCMIS or for information in DDCMIS.
Elec1-06	VI/PART-E	**TENDER DRAWINGS**			9587-999-POE-J-002 to 9587-999-POE-J-008	9587-999-POE-J-002 to 9587-999-POE-J-008
Elec1-07	VI/PART-B	**SUBSECTION B-08 HT LT AND CONTROL CABLES, CLAUSE NO: 2.010.00, PAGE 3 OF 7.**			All LT Power cables of size more than 120 Sq.mm shall be XLPE Insulated and sizes shall be of 1Cx150, 1Cx300, 1Cx630, 3Cx150, 3Cx240& 3Cx300 Sq.mm	All LT Power cables of size more than 120 Sq.mm shall be XLPE Insulated and sizes shall be of 1Cx150, 1Cx300, 1Cx630, 3Cx150, 3Cx185, 3Cx240& 3Cx300 Sq.mm
Elec1-08	VI/PART-B	**SUBSECTION B-17 SWITCHYARD, CLAUSE NO: 1.01.21, PAGE 3 OF 97.**			The control & protection panels belong to LARA Stage-II switchyard bays in stage-I area shall be placed in AC kiosk. The kiosk shall be provided with adequate air conditioning, fire alarm system with at least two detectors and it shall be wired to SAS system of 400kV System. **Two nos. of suitable separate power supply from existing LT switchgear shall be provided**	The control & protection panels belong to LARA Stage-II switchyard bays in stage-I area shall be placed in AC kiosk. The kiosk shall be provided with adequate air conditioning, fire alarm system with at least two detectors and it shall be wired to SAS system of 400kV System. **Two nos. of suitable separate power supply**

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	SEC/PART	Sub-Section	Clause No.	Page No.		
					to each AC kiosk to cater power supply to panels and AC separately. All internal power supply distribution shall be provided accordingly. MCC / ACDB, DCDB, EDB etc panels shall be placed in Lara Stage-II switchyard control room building. The Control & protection panels belongs to extension bays of LARA Stage-I switchyard shall be placed in AC kiosk with adequate air conditioning. MCC / ACDB, DCDB , EDB etc panels shall be placed in existing LARA Stage-1 switchyard building. Adequate AC & Ventilation in Control room building and Ventilation of switchgear room / MCC room etc. is to be provided by the contractor for the buildings in the Bidder scope . Specification of AC & Ventilation is specified elsewhere in the specification (Part-B Mechanical).	**from LT switchgear which is under bidders scope as per cl 1.01.30 shall be provided to each AC kiosk to cater power supply to panels and AC separately.** All internal power supply distribution shall be provided accordingly. MCC / ACDB, DCDB, EDB etc panels shall be placed in Lara Stage-II switchyard control room building. The Control & protection panels belongs to extension bays of LARA Stage-I switchyard shall be placed in AC kiosk with adequate air conditioning. MCC / ACDB, DCDB , EDB etc panels shall be placed in existing LARA Stage-1 switchyard building. Adequate AC & Ventilation in Control room building and Ventilation of switchgear room / MCC room etc. is to be provided by the contractor for the buildings in the Bidder scope . Specification of AC & Ventilation is specified elsewhere in the specification (Part-B Mechanical).
Elec1-09	**VI/PART-B**	**SUBSECTION B-02 MOTORS, CLAUSE NO: 3.01.00, PAGE 1 OF 4.**			Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be **Premium Efficiency class-IE3**, conforming to IS 12615, or IEC:60034-30. HT motors shall have minimum design efficiency of 95 %.	Continuous duty LT motors upto 50 KW Output rating (at 50 deg.C ambient temperature), shall be **super Premium Efficiency class-IE4, 50-200 KW shall be of Premium Efficiency class – IE3**, conforming to

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	SEC/PART	Sub-Section	Clause No.	Page No.		
					However, tolerance on this efficiency value shall be applicable as per IEC 60034	IS 12615, or IEC:60034-30. HT motors shall have minimum design efficiency of 95 %. However, tolerance on this efficiency value shall be applicable as per IEC 60034.
Elec1-10	VI/PART-A	SUB SECTION-IIB – ELECTRICAL EQUIPMENTS/SYSTEMS	CLAUSE NO. 1.16.02	PAGE 9 OF 20	400kV Overhead Transmission Line : One (1) No. of 400kV Double Circuit interconnecting overhead Tie line between Lara Stage-I and Stage-II Switchyard with Twin Moose Conductor on towers	400kV Overhead Transmission Line : One (1) No. of 400kV Double Circuit interconnecting overhead Tie line between Lara Stage-I and Stage-II Switchyard with **Quad Moose Conductor on towers**
Elec1-11	VI/PART-A	B0- GENERAL ELECTRICAL SPECIFICATIONS,	CLAUSE NO:3.06.00-J,	PAGE 8 OF 15	The Finally selected Busbar ratings for Switchboards, MCCs, ACDBs and Busducts shall include a 10% margin over the calculated values.	The Finally selected Busbar ratings for Switchboards, MCCs, ACDBs and Busducts shall include a 10% margin over the transformer full load current/calculated values whichever is higher.
Elec1-12	VI/PART-A	SUB SECTION-IIB – ELECTRICAL EQUIPMENTS/SYSTEMS,	CLAUSE NO:1.16.07,	PAGE 12 OF 21	a) Substation Automation System (SAS based on IEC 61850 protocol) for control and protection of all 400kV bays under present scope. OPGW (Min 24 cores, for each Tie line) shall be used for establishing communication between Lara Stage-I and Stage-II Areas.	a) Substation Automation System (SAS based on IEC 61850 protocol with **digitized Process bus** for control and protection of all 400kV bays under present scope **(Stage-II Bays at both Stage-I extension and Stage-II area).** OPGW (Min 24 cores, for each Tie line) shall be used for establishing communication between Lara Stage-I and Stage-II Areas.

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	SEC/PART	Sub-Section	Clause No.	Page No.		
					h) Bus bar protection for all 400kV bays under present scope shall be in bidder's scope.	h) Bus bar protection for all 400kV bays under present scope shall be in bidder's scope. **Duplicate Central Units (CU) for Busbar in Lara Stage-I extension area and Stage-II area shall be considered separately.**
					k) Control, metering, and protections of all 400kV bay systems of stage-II (2X800MW) shall be as per relevant tender SLDs.	k) Control, metering, and protections of all 400kV bay systems of stage-II (2X800MW) shall be as per relevant tender SLDs. **Line Differential protection shall be provided for Tie Line bays (Interconnection between Stage-I extension area and Stage-II area). Separate OPGW shall be considered for each protection channel.**
					q) FOTE (Fiber Optic Terminal End)/PLCC Equipment along with all necessary accessories.	**q)** FOTE (Fiber Optic Terminal End)/PLCC Equipment along with all necessary accessories **shall be considered for all line bays (excluding Tie line bays) in present scope.**

EPC PACKAGE FOR LARA SUPER THERMAL POWER PROJECT, STAGE-II (2x800 MW)
Amendment No. 02 to Technical Specifications Section-VI of Bidding Document No.: CS-9587-001R-2

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	SEC/PART	Sub-Section	Clause No.	Page No.		
Elec1-13	VI/PART-B	SUBSECTION B-17 SWITCHYARD, CLAUSE NO: 8.08.01, 8.08.02, PAGE 35 OF 97.			**8.08.01** The Contractor shall fabricate and install mounting arrangements for the support and installation of all the cables on GI angles / Cable tray supports in the trenches/ above ground.. These mounting shall be fabricated from structural steel members (channels, angles and flats) of the required size. The fabrication, welding and erection of these structures shall conform to the relevant clauses of Part-C0. **8.08.02** Un galvanised M.S. Cable supports shall be painted after installation. The painting shall be in conformity with stipulated in Chapter-C0. All welding works inclusive of the consumables required for fabrication and installation shall be in the scope of the Contractor.	**8.08.01** The Contractor shall fabricate and install mounting arrangements for the support and installation of all the cables on GI angles / Cable tray supports in the trenches/ above ground. These mounting shall be fabricated from structural steel members (channels, angles and flats) of the required size. **Minimum section thickness shall not be less than 4 mm. Weight of zinc coating shall be at least 0.610 kg/m2.** **8.08.02 DELETED**

FORMAT-CONN-TD-2

TECHNICAL CONNECTION DATA TO BE FURNISHED BY THERMAL/ HYDRO/ NUCLEAR GENERATING STATIONS INCLUDING PUMPED STORAGE PROJECTS(PSP) FOR SIGNING OF CONNECTIVITY AGREEMENT FOR INTERCONNECTION WITH THE INTER-STATE TRANSMISSION SYSTEM

A. Introduction

This document is designed to act as a guideline for exchange of technical connection data for the purpose of interconnection of the generation plant with ISTS along with exchange of accurate modelling data. Availability of accurate modelling data shall enable assessment of compliances of applicable regulations, adequacy of power system & assessment of equipment performance for secure and reliable interconnection with the ISTS Grid.

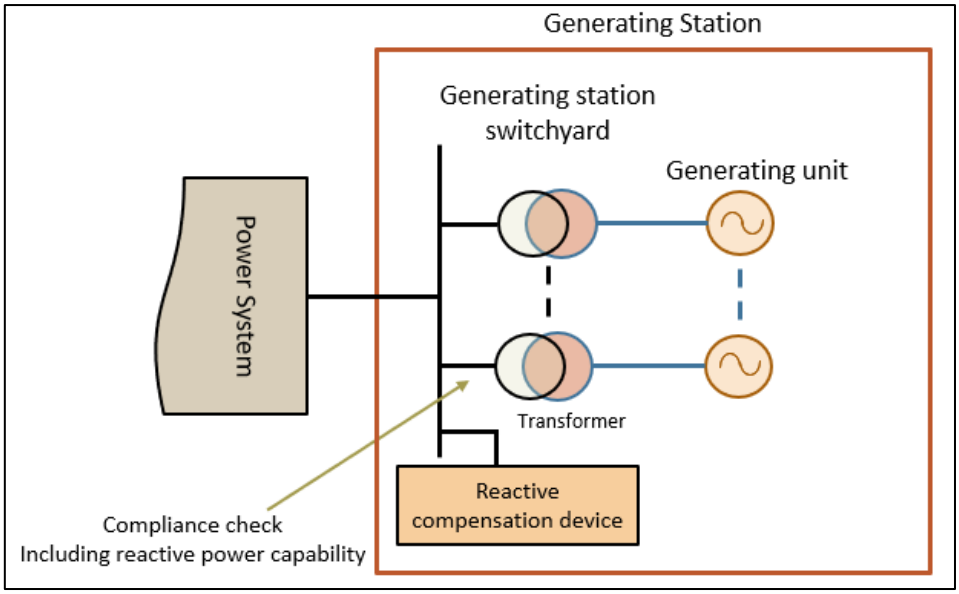
B. Regulation

CEA Technical Standards for Connectivity to Grid, 2007 and its amendments thereof: Clause 6.4d

"Provided that in order to carry out the said study, the requester shall present the mathematical model of the equipment in accordance with the requirements as stipulated by the Appropriate Transmission Utility or distribution licensee, as the case may be."

C. General Considerations

i. The compliances stipulated in CEA Technical Standards for Connectivity to Grid including reactive power capability of the unit shall be assessed at the unit level (high voltage terminal of generating unit).



ii. The applicant shall follow the industry best practices and applicable industry standards in respect of the equipment installation and its operation and maintenance.

D. Compliance with existing rules and regulations

All applicants seeking connection to the grid shall comply with all the applicable regulations as enacted or amended thereof from time to time, including the following:

i. Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007;

ii. Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010;

iii. Central Electricity Authority (Measures Relating to Safety & Electric Supply) Regulations, 2010;

iv. Central Electricity Regulatory Commission (Communication System for InterState Transmission of Electricity) Regulations,2017;

v. Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006;

vi. Central Electricity Regulatory Commission (Connectivity and General Network Access to the inter-State Transmission System) Regulations, 2022;

vii. Central Electricity Regulatory Commission (Fees and Charges for Regional Load Despatch Centres) Regulations, 2019;

viii. Central Electricity Authority (Technical Standards for Communication System in Power System Operation) Regulations, 2020;

ix. Central Electricity Regulatory Commission (Furnishing of Technical Details by the Generating Companies) Regulations, 2009;

x. Central Electricity Authority (Cyber Security in Power Sector) Guidelines, 2021;

xi. Any other regulations and standards as specified from time to time.

E. Description

i. Coal-fired thermal generation plant

Coal-fired power plants typically burn coal to heat a boiler that produces high-temperature, high-pressure steam that is passed through the turbine to produce mechanical energy. Synchronous machines coupled with the steam turbine convert mechanical energy into electrical energy at a suitable voltage level. Typical arrangement of coal-fired thermal generator is depicted in Figure-13.

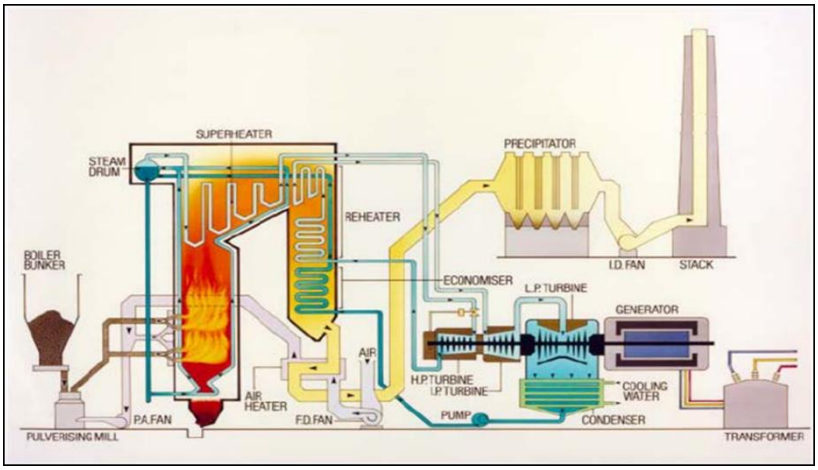


Figure-13: Typical schematic of coal fired thermal generation plant

Generally, coal-fired thermal generating units are high speed machines and therefore the construction of rotor is cylindrical in nature.

ii. Hydropower plant

Hydro Power Plant uses water as the source of energy wherein conversion of water kinetic energy is converted into mechanical energy by suitable turbines. The synchronous generator coupled with the turbine, in turn, converts mechanical energy into electrical energy at an appropriate voltage level. Typical arrangement of a hydro-power generating station is depicted in Figure 14. Based on the topology of quantum of water /storage, hydro-power plants are broadly classified into the following categories:

a. Run-of-river

Run of river hydropower projects have no, or very little, storage capacity behind the dam and generations are dependent on the timing and size of river flows.

b. Reservoir (HPP)

Reservoir-based hydropower schemes usually have dams for the storage of water and the large volume of water contained helps in regulating water flows during different seasonal conditions. A hydroelectric reservoir makes use of the potential energy of water for generating electricity. Water is held back by the dam, and released through a turbine, which in turn produces electricity. Reservoir capacities can be small or very large, depending on the characteristics of the site and the economics of dam construction.

c. Pumped storage (PSP)

Pumped-storage hydroelectricity (PSH), or pumped hydroelectric energy storage (PHES), is a type of hydroelectric energy storage used by electric power systems for load balancing. The method stores energy in the form of gravitational potential energy of water, pumped from a lower elevation reservoir to a higher elevation. Low-cost surplus off-peak electric power is typically used to run the pumps. During periods of high electrical demand, the stored water is released through turbines to produce electric power.

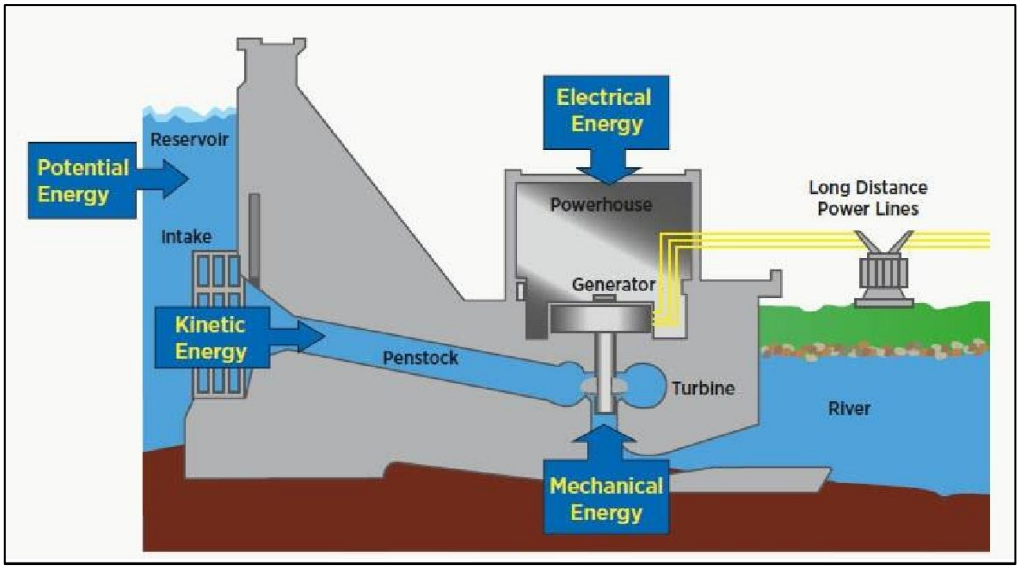


Figure-14: Typical schematic of a hydro power plant

Types of hydro- turbines

Based on the construction of turbines used within hydro-electric plants, it can be broadly classified into the following three types:

a) Pelton wheel turbine
b) Kaplan Turbine
c) Francis Turbine

iii. Gas power plant classification

The gas turbine power plants which are used in the electric power industry are classified into two main groups as per the cycle of operation and configuration:

a. Open cycle gas turbine (OCGT)

In the open cycle, air at the ambient condition is drawn into the compressor (either an axial-flow or centrifugal compressor) where its temperature and pressure are raised. The high-pressure air proceeds into the combustion chamber, where the fuel is burnt at constant pressure. The high-temperature gases then enter the turbine where they expand to the atmospheric pressure while producing power output. The exhaust gases leaving the turbine are thrown out (not recirculated), causing the cycle to be classified as an open cycle. All masses are typically on the same shaft (the compressor, combustion chamber, and turbine). This is also

referred to as a “single-shaft”gas turbine as depicted in Figure-15.

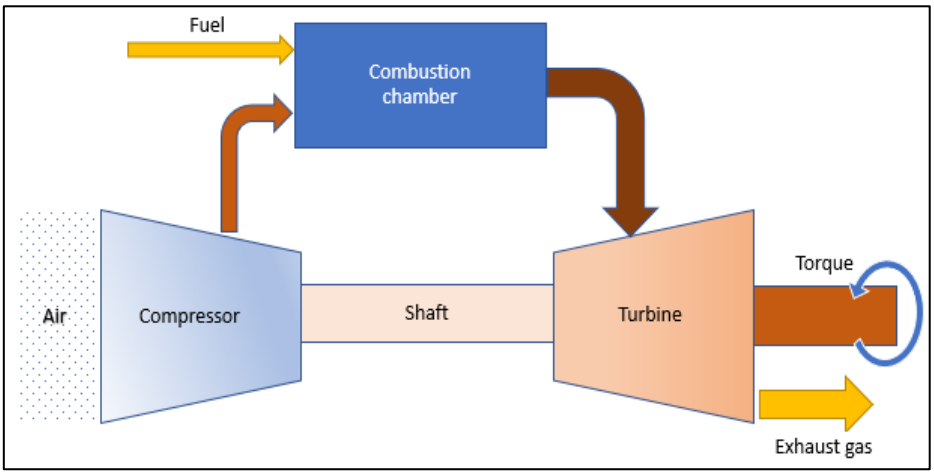


Figure-15: Open cycle gas turbine

b. Closed cycle gas turbine (CCGT)

In a closed cycle gas turbine, working fluid does not come in contact with atmospheric air. The compression and expansion process remain the same but the combustion process is replaced by a constant pressure heat addition process from an external source. The exhaust process is replaced by constant pressure heat rejection process to the ambient air. The exhaust gases leaving the turbine are cooled in heat exchanger called sink where it rejects heat. Therefore, in this cycle, the same working fluid is recirculated, causing cycle to be classified as close cycle as shown in Figure 16.

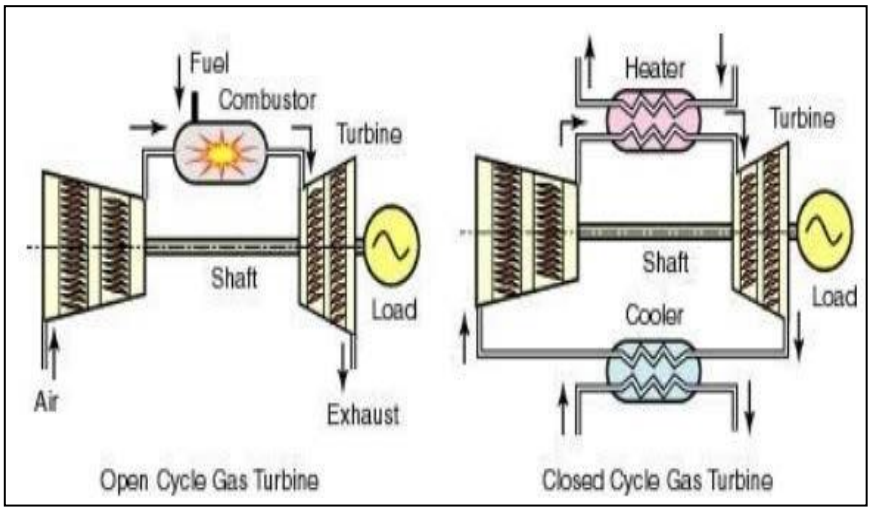


Figure 16: Typical Open and Close cycle Gas Turbine

iv. Reactive power capability of thermal generating unit

As per CEA Technical Standards for Connectivity to Grid, thermal generating unit shall be capable of operating at rated output for power factor varying 0.85 lagging (over-excited) to 0.95 leading (under-excited). Provided further that the above performance shall also be achieved with voltage variation of ± 5% of nominal, frequency variation of +3% and -5% and combined voltage and frequency variation of ±5%. However, for gas turbines, the above performance shall be achieved for voltage variation of ±5%.

During over-excited mode of operation (lagging power factor), the machine is required to deliver active and reactive power (Ex-Bus) simultaneously whereas during under-excited operation mode (leading power factor), the machine shall inject active power while absorbing reactive power (Ex-Bus). The convention to be followed in this regard is depicted in Figure-17.

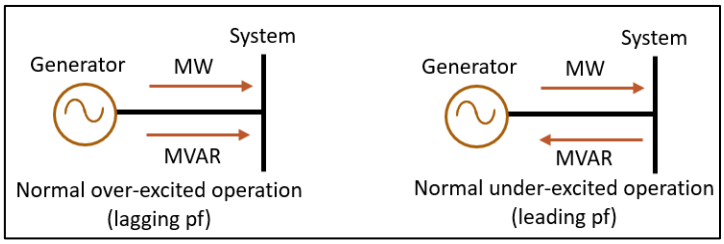


Figure-17: Leading and lagging operation of generator unit

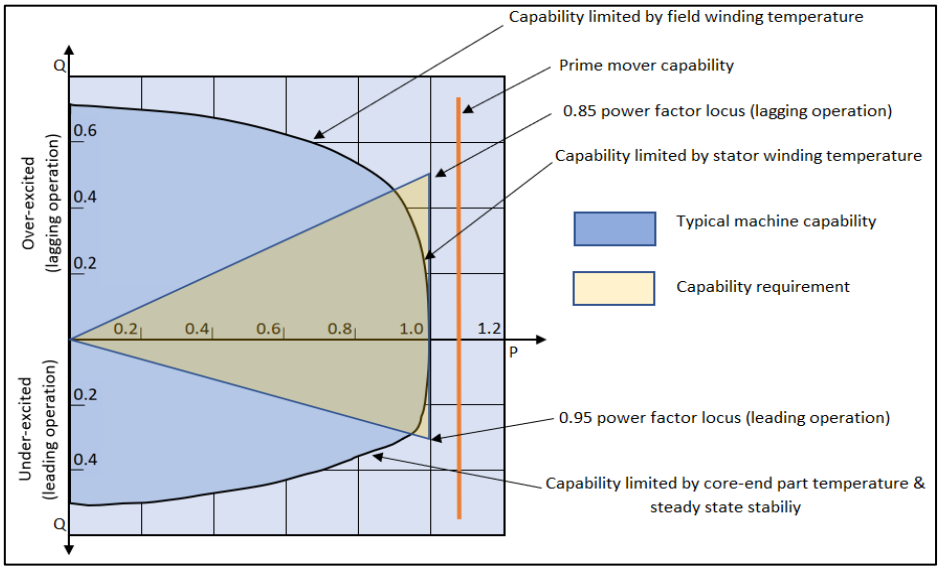


Figure-18: Typical reactive capability curve of thermal generating unit

The performance of machine is constrained due to rotor, stator & iron core parts temperature. Therefore, based on the limitations imposed due to rotor winding temperature, stator winding temperature, iron core parts temperature & stability limit, the final capability of the machines shall be arrived after considering such conditions. The reactive capability is expressed in terms of P-Q curve as depicted in Figure-18.

Synchronous machines shall be capable of demonstrating continuous rated output (active and reactive power) with the variations of ±5% voltage variations and frequency variations of + 3% and -5% alongwith combined voltage and frequency variations. The overall working envelope of machine considering both constraints (voltage and frequency) is shown in Figure-19. In addition to constraints indicated in the above P-Q curve, any other limitations including prime mover capability, Valve Wide Open Condition, etc. are also required for evaluating machine performance.

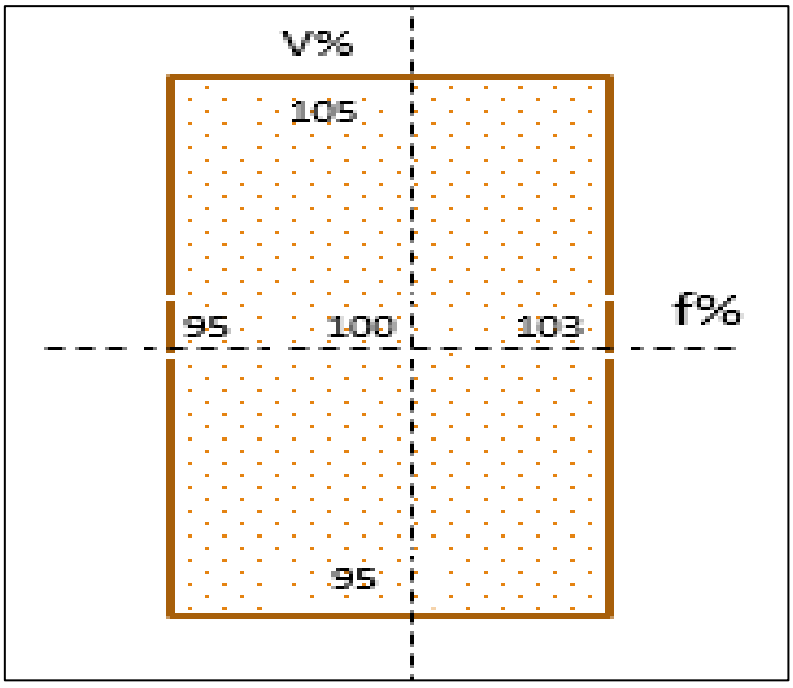


Figure-19: Combined voltage and frequency dependence on machine capability

v. Short circuit ratio (SCR) of Generating Unit

It is defined as the ratio of the field current required to generate rated voltage on an open circuit to the field current required to circulate rated armature current on

sustained symmetrical short-circuit with the machine running at rated speed. It affects the physical size, operating characteristics and cost of the synchronous machine. For a lower value of SCR, the machine shall be very sensitive to the load variations and accordingly, the percentage variation in terminal voltage shall be higher. SCR is a measure of stability of an electromagnetic generator. Also, the synchronising power of machine with low SCR is less resulting in lower stability limit. The typical SCR derived from OCC and SCC are depicted in Figure-20.

$$SCR = \frac{I_f \ for \ rated \ open \ circuit \ voltage}{I_f \ for \ rated \ short \ circuit \ current} = \frac{oa}{od}$$

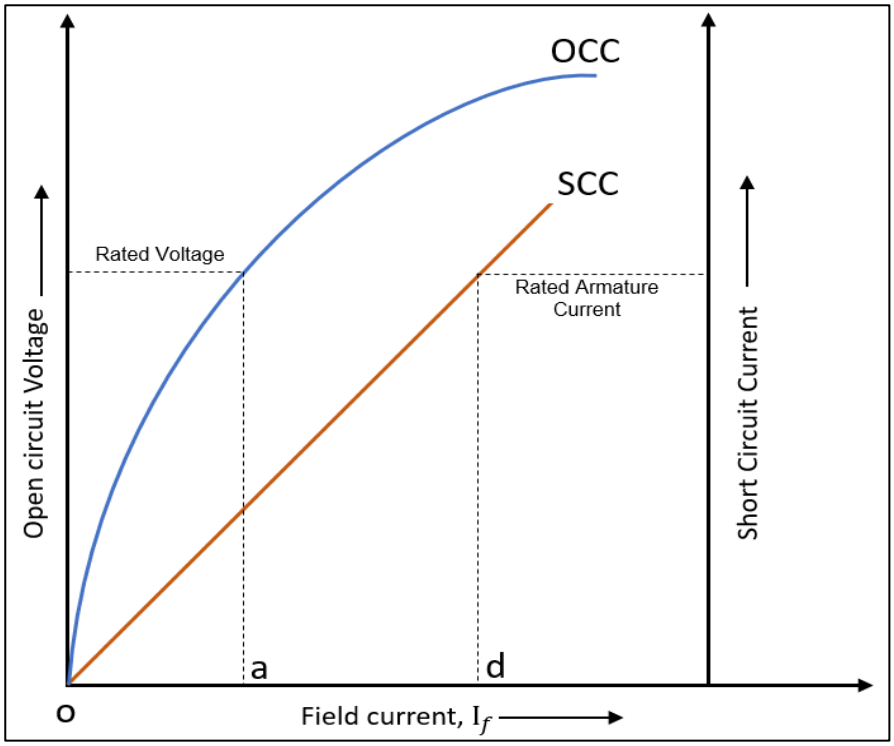


Figure-20: SCC and OCC characteristics

vi. Droop characteristics of Generating unit

Droop is one of the key parameter of the generating unit demonstrating the changes in active power in response to frequency changes outside the dead band as depicted in Figure-21. Droop corresponds to the deviation in frequency from the dead band *(*as a percentage of the nominal 50 Hz) that would result in a 100% change in generator MW output from the maximum level. Droop of a

synchronous machine shall be evaluated using equation given hereunder.

$$\text{Droop } \% = 100 \text{ X} \frac{\Delta F / F}{\Delta P / P}$$

Δ is the frequency deviation beyond the upper or lower limit of generator's dead band (in Hz)

ΔP is active power change (in MW); P is the Maximum Operating Level (in MW)

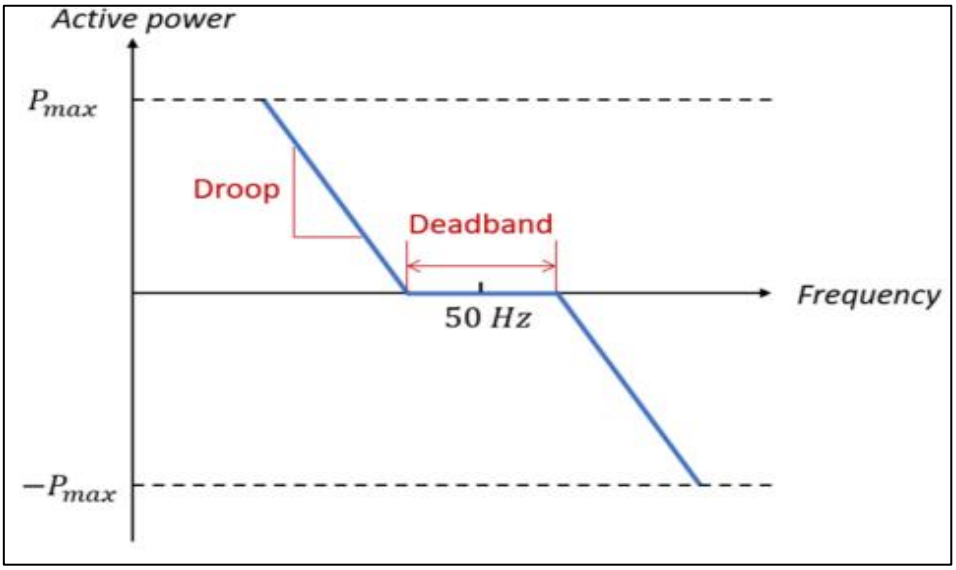


Figure-21: Droop characteristics of synchronous generator

vii. Simulation models for conventional generating stations

Conventional Generators shall be modelled using the generic model available in PSS/E model library. The applicable models for Synchronous machines, Excitation systems, Turbine-Governor and Power System Stabilizers are given hereunder *(Source: PSS/E model library)*. Applicants can also submit the model data corresponding to another PSS/E based generic model if the performance matches such model. Typical models used for simulating generating units are depicted in Figure-22.

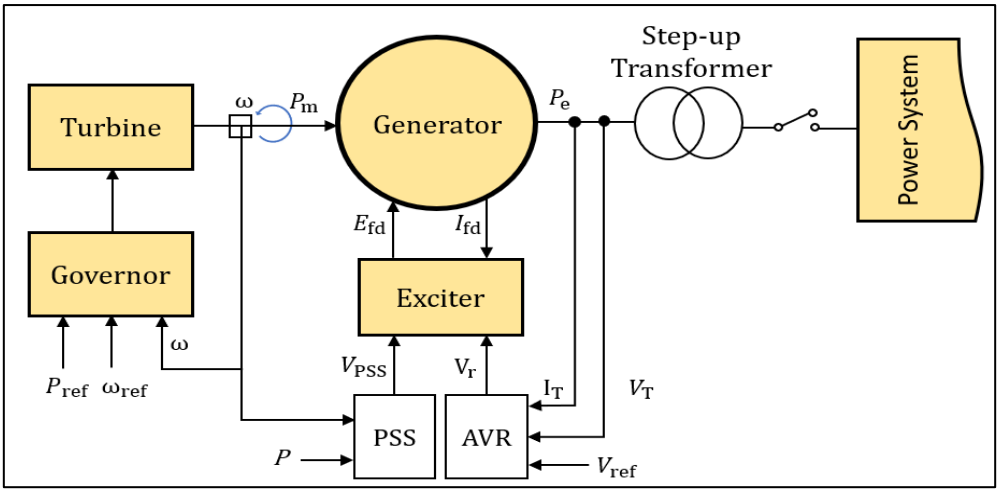


Figure-22: Components of conventional generating unit

(a) Generic Models for Synchronous machine

Hydro machines	Thermal, Gas, Diesel & Nuclear machines
GENSAL- Salient pole machine with quadratic saturation function GENSAE – Salient pole machine with exponential saturation function	**Round Rotor** GENROU –Machine model with quadratic saturation function GENROE – Machine model with exponential saturation function
	Salient Pole Machine GENSAL –Machine with quadratic saturation function GENSAE – Machine with exponential saturation function

(b) Excitation system model

PSS/E-based generic models for excitation systems are broadly classified into three groups:

- Type DC: for excitation systems with a DC exciter
- Type AC: for excitation systems with an AC exciter
- Type ST: for excitation systems with a static exciter

The following table shows the types of models separated into their respective groups.

DC exciter	AC exciter	Static excitation system
Type DC1A	Type AC1A	Type ST1A
Type DC2A	Type AC2A	Type ST2A
Type DC3A	Type AC4A	Type ST3A
Type DC4B	Type AC5A	Type ST4B
	Type AC6A	Type ST5B
	Type AC7B	Type ST6B
	Type AC8B	Type ST7B
		Type ST7C

(c) Power system stabilizer

Power System Stabilizer (PSS) is a control system applied at a generator that monitors variables such as current, voltage and shaft speed and sends the appropriate control signals to the voltage regulator to improve the damping of power system oscillations.

The most important aspect when considering a PSS model is the number of inputs. The following table shows the type of models separated based on the inputs:

Type	Inputs	Remarks
PSS1A	Single input	Two lead-lags

Type	Inputs	Remarks
		Inputs can either be speed, frequency, or power
PSS2B	Dual input	Rotational speed deviation and electrical power deviation as inputs Most common type Supersedes PSS2A (three versus two lead lags)
PSS3B	Dual input	Rotational speed deviation and bus frequency deviation as inputs Stabilizing signal is a vector sum of processed signals

(d) Generic models for steam turbine-governor

The following table is a list of generic models of steam turbines:

Type	Name	Remarks
BBGOV1	Brown – Boveri turbine governor model	Mainly used for a steam turbine with electrical damping feedback
IEEEG1	IEEE type 1 Speed-Governor Model	Used to represent non-reheat, tandem compound, and cross compound types.
IEEEG2	IEEE Type 2 Speed-Governing Model	Linearized model for representing a hydro turbine-governor and penstock dynamics
IEEEG3	IEEE type 3 turbine-governor model	Includes a more complex representation of the governor controls than IEEEG2
IEESGO	IEEE Standard Model	Simple model of reheat steam turbine
TGOV1	Steam-turbine governor	Mainly used for a steam turbine with reheater
TGOV2	Steam –turbine governor with fast valving	Fast valving model of steam turbine
TGOV3	Modified IEEE Type 1 Speed-Governing Model with fast	Modification of IEEEG1 for fast valving studies

Type	Name	Remarks
	valving	
TGOV4	Modified IEEE Type 1 Speed-Governing Model with PLU and EVA	Model of steam turbine and boiler, explicit action for both control valve (CV) and inlet valve (IV), main reheat and LP steam effects and boiler
TGOV5	IEEE Type 1 Speed-Governor Model Modified to Include Boiler Controls	Most common type of governor model, based on TGOV1 with boiler controls
TURCZT	Czech hydro or steam turbine governor model	General-purpose hydro and thermal turbine- governor model. Penstock dynamic is not included in the model
CRCMGV	Cross-compound turbine	-

(e) Generic models for hydro turbine-governor

The following table is a list of common generic models of hydro turbines:

Type	Name	Remarks
HYGOV	Hydro-turbine Governor	Simple hydro model with unrestricted head race and tail race, no surge tank
HYGOV2	Hydro-turbine Governor	Linearized hydro turbine governor model
HYGOVDU	Hydro turbine-governor model with speed dead band	Added asymmetrical deal band
HYGOVM	Hydro-Turbine Governor	Includes detailed representation of surge chamber
WEHGOV	Woodward Electric Hydro Governor Model	Woodward hydro governor with a non-linear model for penstock dynamics
HYGOVT	Hydro Turbine-Governor	Travelling-wave solution applied to

Type	Name	Remarks
	traveling wave model	penstock and tunnel
PIDGOV	Hydro Turbine Governor	Straight forward penstock configuration with PID governor
HYGOVR1	Fourth order lead-lag hydro-turbine	for a unit with digital controls, allows a nonlinear relationship between the gate position and power
TURCZT	Czech hydro or steam turbine governor model	General-purpose hydro and thermal turbine- governor model. Penstock dynamic is not included in the model
TWDM1T	Tail water depression hydro governor model 1	Same basic permanent and transient droop elements as the HYGOV model, but it adds a representation for a tail water depression protection system
TWDM2T	Tail water depression hydro governor model 2	Same as TWDM1T and uses a governor proportional-integral-derivative (PID) controller
WPIDHY	Woodward PID hydro governor model	Includes governor controls representing a Woodward PID hydro governor. The model includes a nonlinear gate/power relationship and a linearized turbine/penstock model.
WSHYDD	WECC double derivative hydro governor model	Double-derivative hydro turbine-governor mode. Includes two dead band, also includes a nonlinear gate/power relationship and a linearized turbine/ penstock model
WSHYGP	WECC GP hydro governor plus turbine model	WECC GP hydro turbine-governor model with a PID controller, penstock

Type	Name	Remarks
		dynamics are similar to those of the WECC WSHYDD

(f) Generic models for gas turbine-governor

The following table is a list of common generic models of gas turbines:

Type	Name	Remarks
GAST	Gas turbine governor	Simplified model for industrial gas turbine (i.e. OCGT)
GAST2A	Gas turbine governor	More detailed GT from GAST. Governor can be configured for droop or isochronous control. Includes temperature control
GASTWD	Woodward Gas Turbine-Governor model	Same detail of turbine dynamics as GAST2A but with a Woodward governor controls
WESGOV	Westinghouse Digital governor for Gas Turbine	Westinghouse 501 combination turbine governor
GGOV1	GE General Governor/Turbine model	General purpose GE GT model (neglects ICV control)
PWTBD1	Pratt & Whitney Turboden turbine-governor	Turbine load PI control with valve and look-up table
URCSCT	Combined cycle, single shaft turbine- governor model	-
URGS3T	WECC gas turbine governor	-

Transfer function block diagrams of the above-mentioned generic models are given in **Annexure-6**.

Technical Connection Data and compliance Report submission by Generators (Thermal/Hydro/Nuclear) and PSP

A. General details

1.	Name of the Applicant Company	:	
2.	URN No.	:	
3.	Details of Grant of Connectivity (a) Connectivity Intimation No. (b) Date	:	
4.	Quantum of Connectivity Granted (MW) (Maximum injection & Maximum drawal to be indicated for PSP)	:	
5.	Location of Generation Plant Latitude Longitude	: : :	(The applicant shall also attach the Survey of India Toposheet indicating the location of the facility}
6.	Installed capacity of Generating station/PSP (MW)	:	
7.	Address for Correspondence	:	
8.	Contact Person 8.1 Primary Contact Person (a) Name (b) Designation (c) Phone No. (d) E-mail 8.2 Alternate Contact Person (a) Name (b) Designation (c) Phone No. (d) E-mail	:	
9.	Expected Date of Commercial Operation	:	

B. Technical Connection data

1. Details of Generation Plant /PSP

1.	Type of Generation Plant (Hydro, Thermal, Gas, Diesel, Nuclear, PSP, Nuclear)	:	
2.	Auxiliary Consumption (%)	:	
3.	Maximum Export Capacity Required (MW)	:	
4.	Maximum Import Capacity required This is the amount of import capacity that the site will require during startup (MVA)	:	
5.	Maximum power required by plant during motoring mode (in case of PSP) (MW) and duration of motoring mode considering reservoir size	:	
6.	Round trip Efficiency(%) for PSP	:	
7.	Rsesrvoir Details for PSP (MWL/ FRL/ MDDL) in Meters	:	
8.	Station house load during normal operating conditions (MW/MVAR)	:	
9.	Expected running regime e.g. base load, peaking, etc	:	
10.	Basic System details	:	The applicant shall submit the basic system details as per Annexure-1

2. Interconnecting Transmission Line (ITL)

1.	Name of Sending End S/s (Generator end)	:			
2.	Name of Receiving End S/s (ISTS end)	:			
3.	Voltage level (kV)	:			
4.	Length of ITL (Kms)	:			
5.	Tower Configuration (S/c, D/c, M/c)	:			
6.	Type of Conductor	:			
7.	OPGW available (Yes/No)	:			
8.	No. of Fibre in OPGW (24/48F)	:			
9.	OPGW/Line Shared with another GenCo or another plant of same owner	:			
		R (pu)	**X (pu)**	**B (pu)**	
10.	Conductor positive sequence R X B parameters in pu/km/ckt (considering 100MVA base)				
11.	ITL positive sequence R X B parameters in pu/km/ckt (considering 100MVA base)				
12.	ITL zero sequence R X B parameters in pu/km/ckt (considering 100MVA base)				

Note: *Applicant shall attach the details of ITL as per* ***Annexure-2***

3. Generating Unit details

Sl. No.	Particulars	Unit – 1	Unit - 2	Unit – 3
1.	Unit Rating (MVA)			
2.	Rated terminal voltage (kV)			
3.	Rated power factor			
4.	Rated frequency (Hz)			
5.	Rated speed (rpm)			
6.	Rated excitation (in Amperes and Volts)			
7.	Type of synchronous machine (Round rotor or salient pole), Nos. of Poles			
8.	Type of Generator Cooling System (Water, Hydrogen, etc.)			
9.	Normal Max. Continuous Generation Capacity at Normal operating temperature (MW)			
10.	Normal Max. Continuous Export Capacity at Normal operating temperature (MW)			
11.	Maximum (Peaking) generating Capacity at min ambient air temperature (MW)			
12.	Maximum (Peaking) Export Capacity at min ambient air temperature (MW)			
13.	Minimum Continuous Generating Capacity (MW)			
14.	Minimum Export Generating Capacity (MW)			
15.	Normal Maximum Lagging MVAR at rated MW output			

16.	Normal Maximum Leading MVAR at rated MW output			

Note: *Applicant shall append unit nos. in case no. of units are more than 3*

4. Generator Data for Fault (Short Circuit Studies)

1.	Direct Axis Transient Reactance	X_d'	
2.	Sub-transient Reactance	X_d"	
3.	Synchronous Reactance	X_s	
4.	Zero Sequence Reactance	X_o	
5.	Negative Sequence Reactance	X_2	

5. Dynamic Simulation Data

1.	Direct Axis Positive Phase Sequence Synchronous Reactance in pu	X_d	
2.	Quadrature Axis Positive Phase Sequence Synchronous Reactance in pu	X_q	
3.	Direct Axis Transient Reactance (unsaturated) in pu	X_d'	
4.	Quadrature Axis Transient Reactance (unsaturated) in pu	X_q'	
5.	Sub-Transient Reactance (unsaturated) in pu	X_d"	
6.	Armature Leakage Reactance in pu	X_l	
7.	Direct Axis Transient open circuit Time Constant (Secs)	T_{do}'	
8.	Direct Axis Sub-transient open circuit Time Constant (Secs)	T_{do}"	
9.	Quadrature Axis Transient open circuit Time Constant (Secs)	T_{qo}"	

10.	Quadrature Axis Sub-transient open circuit Time Constant (Secs)	T_{qo}"	
11.	Inertia constant of total rotating mass (generator, AVR, turbo-governor set) H in MWs/MVA	sec	
12.	Speed Damping D		
13.	Saturation constant S (1.0) in p.u.		
14.	Saturation constant S (1.2) in p.u.		

Note:

1. *Applicant shall attach the* ***Generator open circuit and short circuit characteristics*** *indicating the following graphs:*

   a. *Graph of excitation current versus terminal voltage and stator current;*

   b. *No load excitation current;*

   c. *Excitation current at rated current.*

2. *Applicant shall attach the* ***Generator*** *V-curve indicating terminal (armature) current versus generating unit field voltage.*

3. *Applicant shall attach the Complete Generator OEM Technical Datasheet indicating generator parameters including impedance & time constants, etc*.

6. Excitation System

Type of Automatic Voltage Regulator (AVR)		
1.	Manufacturer and product details	
2.	Type of control system:- Analogue or digital	
3.	As found settings (obtained either from HMI or downloaded from controller in digital systems)	
Type of excitation system		
4.	Static excitation system **OR** Indirect excitation system (i.e. rotating exciter) AC exciter, or DC exciter	
5.	**Details of AVR converter** - Rated excitation current (converter rating in Amperes)	
6.	Six pulse thyristor bridge or PWM converter	
Source of excitation supply		
7.	Excitation transformer or auxiliary supply (Details thereof)	
8.	If excitation transformer, nameplate information such as type of transformer, HV and HV winding ratings, positive and zero sequence impedance, tap positions, voltage step per tap is required.	
Excitation limiters		
9.	Under Excitation Limiters settings	
10.	Over Excitation Limiters settings	
11.	Voltage/frequency limiter	
12.	Stator current limiter	
13.	Minimum excitation current limiter	
Power System Stabilizer		

14.	Is the AVR equipped with a PSS (In accordance with CEA Technical Standards for Connectivity to Grid, 2007 as amended)	
15.	How many input Channels does the PSS have? (speed, real power output or both	
	If the PSS uses speed, is this a derived speed signal (i.e. synthesized speed signal) or measured directly (i.e. actual rotor speed)?	

Note:

1. *Applicant shall attach the drawings of the excitation system (supplied by OEM) along with excitation system SLD.*

2. *Applicant shall attach the saturation curves of the exciter (if applicable – see Type AC and DC)*

7. Two Winding Transformer Data

1.	Rating Capacity (HV-LV)	
2.	Voltage rating (kV) (Line to Line)	
3.	Number of Power Transformers	
4.	Cooling Type	
5.	Rating at different cooling as mentioned above	
6.	Type of Transformer (Constant Ohmic impedance/ Constant percentage Impedance)	
7.	Transformer vector Group	
8.	Tap changer (ON Load Tap changer)	
9.	Number of steps and step size	
10.	Neutral earthing (solid or through reactance)	
11.	% Impedance at 75ºC (HV-LV)	
12.	% Resistance at 75ºC (HV-LV)	
13.	% Reactance at 75ºC (HV-LV)	
14.	Transformer positive sequence resistance (R_1) in pu	
15.	Transformer positive sequence reactance (X_1) in pu	
16.	Transformer zero sequence resistance (R_0) in pu	
17.	Transformer zero sequence reactance (X_0) in pu	
18.	Nature of Tap Changer (on load/off load)	
19.	Number of steps and step size	

8. Three Winding Transformer Data

1.	Rating Capacity (HV-LV, HV-IV, IV-LV)	
2.	Voltage Ratio (Line to Line)	
3.	Number of Power Transformers	
4.	Cooling Type	
5.	Rating at above different cooling	
6.	Type of Transformer (Constant Ohmic impedance/ Constant percentage impedance)	
7.	Transformer Vector Group	
8.	Tap changer (ON/OFF Load Tap changer)	
9.	Number of steps and step size	
10.	Neutral earthing (solid or through reactance)	
11.	% Impedance at 75ºC (HV-IV)	
12.	% Resistance at 75ºC (HV-IV)	
13.	% Reactance at 75ºC (HV-IV)	
14.	% Impedance at 75ºC (HV-LV)	
15.	% Resistance at 75ºC (HV-LV)	
16.	% Reactance at 75ºC (HV-LV)	
17.	% Impedance at 75ºC (IV-LV)	
18.	% Resistance at 75ºC (IV-LV)	
19.	% Reactance at 75ºC (IV-LV)	
20.	Transformer Vector group	
21.	Positive sequence resistance (R_1HL_1) between HV/IV in pu	
22.	Positive sequence reactance (X_1HL_1) between HV/IV in pu	
23.	Zero sequence resistance (R_0HL_1) between HV/IV in pu	

24.	Zero sequence reactance (X_0HL_1) between HV/IV in pu	
25.	Positive sequence resistance (R_1HL_2) between HV/LV in pu	
26.	Positive sequence reactance (X_1HL_2) between HV/ LV in pu	
27.	Transformer zero sequence resistance (R_0HL_2) between HV/LV in pu	
28.	Zero sequence reactance (X_0HL_2) between HV/LV in pu	
29.	Positive sequence resistance ($R_1L_1L_2$) between IV/ LV in pu	
30.	Positive sequence reactance ($X_1L_1L_2$) between IV/LV in pu	
31.	Zero sequence resistance ($R_0L_1L_2$) between IV/LV in pu	
32.	Zero sequence reactance ($X_0L_1L_2$) between IV/LV in pu	
33.	Positive sequence resistance ($R_1HL_1//L_2$) between HV/(IV+LV) in pu	
34.	Positive sequence reactance ($X_1HL_1//L_2$) between HV/(IV+LV) in pu	
35.	Zero sequence resistance ($R_0HL_1//L_2$) between HV/(IV+LV) in pu	
36.	Zero sequence reactance ($X_0HL_1//L_2$) between HV/(IV+LV) in pu	

Note: *Applicant shall attach the OEM Technical datasheet for Generator step-up transformer indicating rating, impedance, short circuit parameters.*

9. Shunt Reactor

1.	Rated Voltage (Line to Line) (1.0 pu)	:	
2.	Rated capacity at rated voltage (MVAR)	:	
3.	Three phase unit or Single-phase unit	:	
4.	Cooling system	:	
5.	Rated current	:	
6.	Construction type (Core/Shell)	:	
7.	Neutral Grounding (Solidly earthed/ through reactor)	:	
8.	Range of constant impedance	:	Upto …… pu voltage
9.	Reactor knee point voltage (pu)	:	

Note*: Applicant shall attach the OEM Technical datasheet for Shunt reactor indicating rating, impedance, knee point voltage.*

10. Technical particulars of Turbine:

Applicant shall submit the turbine details of the generating unit as per **Annexure-3.**

11. Data and voice communication

1.	Type Data Gateway (Remote Terminal Unit/ Substation Automation System Gateway)	:	(Whether RTU/ Substation Automation System Gateway; and Number of data ports)
2.	Data Communication connectivity Standard followed (As per interface requirement and other guideline made available by the respective RLDC)	:	(Type of Communication Protocol, i.e. 104 (Ethernet), etc.)

3.	Write here the communication media, interface and capacity being targeted for Connectivity for Data and voice Communication	:	(Communication media: For example fibre optics, PLCC, etc. Interface: Ethernet, G.703 etc Capacity: 1200baud, 64Kbps, 2 Mbps, etc)

12. Modeling details:

Applicant shall submit the model parameter data for each component of Generating Unit including Synchronous machine model, excitation system model, turbine governor (as per applicable configuration), power system stabilizer as per **Annexure-4**.

13. PSS/E Single Line Diagram (Single Machine Infinite Bus Model)

Note: Applicant shall attach herewith PSS/E based SLD of generation plant indicating each generating unit.

14. Open circuit magnetization curve

Note: Applicant shall attach herewith the Open circuit magnetization curve of generating unit.

15. Dynamic simulation test

Note: Applicant shall attach herewith the plant response with tables/ appropriate plots of electrical quantities including Voltage, Current, Active power, Reactive Power (Plant and Unit) for all compliances as per CEA Technical Standards for Connectivity to Grid as per **Annexure-5**.

C. The applicant has attached a copy of the affidavit towards the fulfillment of terms and conditions as specified in the CEA (Technical Standards for Connectivity to the Grid) Regulations, 2007 as amended as per **Annexure-A.**

D. Applicant has submitted the details including terminal bay equipment data,

Communication & metering data under its scope as per **Annexure-B.**

E. Applicant has undertaken studies including voltage stability, protection co-ordination, machine dynamics, resonance, sub-station grounding and fault duties of equipment to be installed at generating station premise (as the case may be) so that the overall system performance is not constrained during steady state and contingency conditions. The sub-station grounding design should be such that the earth fault factor of the system should remain below 1.4. Sub-station grounding should be in line with provisions of Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010.

Resonance including ferro-resonance studies has been carried out by applicant covering possible network topologies for excitation of series/parallel resonant point by network impedance scanning and they shall implement the remedial measure at their end in this context.

F. Applicant has further attached the following drawings (soft copy) alongwith application:

1) Site plan in appropriate scale indicating Generators, Transformer, Site building (pdf & autocad copy)

2) Site plan of the ISTS substation at which connectivity granted (pdf and/or autocad copy)

3) General Arrangement (GA) drawing indicating proposed facility

4) Electrical Single Line Diagram (SLD) of the proposed facility detailing all significant items of plant (pdf & autocad copy)

5) Electrical Single Line Diagram (SLD) of ISTS substation at which connectivity granted (pdf & autocad copy)

6) Sub-Station Automation System (SAS) ring diagram indicating interconnections of various IEDs/Engg PC/Gateway etc.

7) Equipment drawings for confirming the ratings

8) CRP (Control & Relay Panel) & scheme drawings containing protection details of the transmission line

9) PLCC/FOTE drawings for the transmission lines under the scheme

10) Details of Communication System

11) Detailed calculation sheet for deriving the maximum ampacity of the conductor as per IEEE-738 Standards, Central Electricity Authority (Technical Standards for Connectivity to Grid), Regulations 2007 and its amendments thereof, Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010 & CEA Transmission Planning Criteria, 2013 and its amendments thereof.

This is to certify that the above data submitted with the application are pertaining to Connectivity with ISTS sought. Further, any additional data sought for processing the application shall be furnished.

Authorized Signatory of Applicant

Name:

Designation:

Seal:

Place:

Date:

Annexure-A

Affidavit to be submitted by the grantee (on non-judicial Stamp Paper of Rs. 10/-) towards fulfilment of various compliances as specified in the CEA (Technical Standards for Connectivity to the Grid) Regulations, 2007 and its amendments thereof (to be provided by company authorized signatory duly authorized vide board resolution)

Date……

Connectivity Intimation No: ……. Connectivity intimation date: …….

I ……(Name)…….S/o Shri ……. (Father's name) working as …….. (designation) in …… (Name of the Applicant organization / entity) ……..…..., having its registered office at …… (Address of the Applicant organization / entity) ……, do solemnly affirm that ..…..…… (name of generating station along with Installed capacity & location of connectivity granted by CTU) complies with all applicable provisions as laid out in the Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 and its amendments thereof and CERC (Connectivity and General Network Access to Inter State Transmission System) Regulations, 2022 and directions through various orders including the following:

1. The excitation system for every generating unit:

    a) have state of the art excitation system

    b) have Automatic Voltage Regulator (AVR) (for generators of 100MW rating and above)

    c) The Automatic Voltage Regulator of generator of 100 MW and above shall include Power System Stabilizer (PSS)

2. The short circuit ratio of generator is as per IEC-34

3. The generator transformer winding has delta construction on low voltage side and star connection on high voltage side. Star point of high voltage side is effectively(solidly) earthen so as to achieve earth fault factor of 1.4 or less

4. All generating machines irrespective of capacity have electronically controlled governing system with appropriate speed/load characteristics to regulate frequency. The governors of thermal generating units have a droop of 3 to 6% and those of hydro generating units 0 to 10%.

5. Generating Unit is capable of operating at rated output for power factor varying between 0.85 lagging (over-excited) to 0.95 leading (under-excited).

6. The above performance is also achieved with voltage variation of ± 5% of nominal, frequency variation of + 3% and -5% and combined voltage and frequency variation of ±5%. However, for gas turbines, the above performance shall be achieved for voltage variation of ±5%. Provided also that all hydro-electric generating units, where Techno-Economic Concurrence has been accorded by the Authority (CEA) under section 8 of the Act, shall be capable of operating at the rated output at the power factor as specified in such techno-economic concurrence.

7. The coal and lignite based thermal generating unit is capable of generating up to 105% of Maximum Continuous Rating (MCR) (subject to maximum load capability under Valve Wide Open Condition) for short duration to provide the frequency response.

8. The hydro generating units are capable of generating up to 110% of rated capacity (subject to rated head being available) on continuous basis.

9. Every generating unit have standard protections to protect the units not only from faults within the units and within the station but also from faults in transmission lines. For generating unit having rated capacity greater than 100 MW, two independent sets of protections acting on two independent sets of trip coils fed from independent Direct Current (DC) supplies shall be provided. The protections are not be limited to the Local Breaker Back-up (LBB) protection

10. Hydro generating units having rated capacity of 50 MW and above are capable of operation in synchronous condenser mode, wherever feasible. Provided that hydro generating units commissioned on or after 01.01.2014 and having rated capacity of 50 MW and above shall be equipped with facility to operate in

synchronous condenser mode, if necessity for the same is established by the: interconnection studies.

11. Bus bar protection has been provided at the switchyard of generating station.

12. Automatic synchronization facilities have been provided.

13. The station auxiliary power requirement, including voltage and reactive requirements, did not impose operating restrictions on the grid beyond those specified in the Grid Code.

14. In case of hydro generating units, self-starting facility has been provided. The hydro generating station also have a small diesel generator for meeting the station auxiliary requirements for black start.

15. The sub-station associated with the generating station is in conformity with the provisions specified in respect of “Sub-station” under Part III of CEA (Technical Standards for Connectivity to Grid) Regulations, 2007 and its amendments thereof.

I am aware that in case any discrepancies / incompleteness are found in the documents submitted to CTU, the connection offer (CONN-TD-5) / connectivity agreement (CONN-CA-6) shall not be processed further. I am also aware that if at any stage any falsity / inaccuracy / incorrectness is detected in the documents / statements …….. (name of generator) shall be solely liable for disconnection from the Grid along with all associated liabilities / consequences in this regard.

Name of the Authorised Signatory:

Signature:

Company Stamp (mandatory):

Annexure-B

Data Format-I

A. Generation switchyard/Pooling Station end:

1.	Name of substation and ownership:	
2.	Name of the bay and bay identification number:	

B. Sub-station (ISTS) End at which Connectivity is granted:

1.	Name of substation and ownership:	
2.	Name of the bay and bay identification number:	

Data Format-II-A

Equipment to be provided in the allocated bay meeting the technical standards as per Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 and amendments thereof

Bus switching scheme:

A. Generation/Pooling Station end: [……]

B. ISTS end: […….]

Equipment Details:

Sl. No.	Name of Equipment	Generation Switchyard /Pooling Station end			ISTS Substation End at which Connectivity is granted		
		Type (AIS/GIS/ MTS)	Nos	Ratings	Type (AIS/GIS/ MTS)	Nos	Ratings
For GIS Substation							
1	Circuit Breaker (with PIR /CSD (if required))						
2	Disconnecting Switch						
3	Maintenance Earthing Switch						
4	High speed Earthing switch						
5	CT with core details						
6	Bus PT						

Sl. No.	Name of Equipment	Generation Switchyard /Pooling Station end			ISTS Substation End at which Connectivity is granted		
		Type (AIS/GIS/ MTS)	Nos	Ratings	Type (AIS/GIS/ MTS)	Nos	Ratings
7	Surge Arrester						
For AIS Substation							
1	Circuit Breaker (with PIR /CSD if required))						
2	Isolator (with no. of Earth Switch as required)						
3	CT with core details						
4	CT (Metering)						
5	Line CVT						
6	Bus CVT						
7	PT (Metering)						
8	Wave trap						
9	Surge Arrester						
10	ICT						
11	Bus Reactor						
12	Line Reactor						
13	NGR						
14	NCT						
15	ESS (Energy Storage System)						

Sl. No.	Name of Equipment	Generation Switchyard /Pooling Station end			ISTS Substation End at which Connectivity is granted		
		Type (AIS/GIS/ MTS)	Nos	Ratings	Type (AIS/GIS/ MTS)	Nos	Ratings
16	Any other equipment details (……)						

Note: *In case of more than two substations, the same shall be appended.*

Data Format-II (B)

Protection Equipment to be provided by applicant shall be meeting the technical standards as per Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 and amendments thereof and shall be compatible & matching with the equipment installed at other end

(Please specify type, make and model of all main relays as applicable)

Name of Substation and Voltage level:

A. Generation end/Pooling substation end and Voltage Level:

B. Connectivity substation end and Voltage Level:

Name of Lines along with Tower Configuration (S/c, D/c, M/c**):**

Type of Conductor: (Bundle Configuration, Dia/ Type and Ampacity)

Protection Details:

Sl. No.	**Description**	**Generation Switchyard / Pooling station end**	**ISTS Substation End at which Connectivity is granted**
		Protection Type, Make and Model	
1.	Line protection relay MAIN-I (Distance / Differential)		
2.	Line protection relay MAIN-II (Distance / Differential)		
3.	Auto reclose relays		
4.	Bay Control Unit		
5.	Any Other Protection Equipment		

Note*: In case of more than two substations, the same shall be appended.*

Data Format-III (A)

System Recording Equipment to be provided in the allocated bay meeting the technical standards as per Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 and amendments thereof

Sl. No.	Name of Equipment's	Generation Switchyard / Pooling Station end		ISTS Substation End at which Connectivity is granted	
		Nos.	Ratings	Nos.	Ratings
1.	Event Logger				
2.	Disturbance recorder				
3.	Fault locator				
4.	PLCC details of transmission line				
5.	FOTE details				
6.	Any other equipment (Please indicate)				

***Note**: In case of more than two substations, the same shall be appended.*

Data format-III (B)

Communication Equipment details upto Data Collection Point SCADA equipment shall be meeting the technical standards as per Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 and amendments thereof and shall be compatible to facilitate exchange of data with the existing system installed in the ISTS network

Sl. No	Name of Equipment	Nos.	Description
1.	**Data Acquisition System** - Remote Terminal Unit/SAS/DAS Gateway		
2(a)	**Communication Equipment** SDH required if any i. At the Generating/Pooling station ii. At data collection point (DCP)		
2(b)	**Approach Cable & FODP** i. At the Generating/ Pooling station ii. At data collection point (DCP)		
3	**WAMS** Phasor Measurement Unit(s) for measuring three phase current of all the feeders and three phase bus voltage at *220kV and above Generator		

***Note**: PMU locations shall be as per latest prevailing guidelines of CEA/Prevailing standards*

Data Format –III (C)

Cyber Security compliance as per CEA (Cyber Security in Power Sector) Guidelines 2021

Sl. No.	Name of Equipment	Nos.	Remarks
1.	**Perimeter security** Redundant Firewalls between SAS Gateway/RTU and FOTE		

Data Format –III (D)

Format for Communication inputs for Generator

A. Generator connectivity details with ISTS Station to be provided

1	Generator location	
	Common Pooling Station (CPS) Location (if exists)	
2	Generator Connectivity with CPS (33/220/400kV voltage)	
	Line length from Gen to CPS in km	
3	Provision of communication from pre pooling station to CPS (Fibre/ Leased Line/ Others)	

B. Bay details at ISTS S/s

Sl. No.	Description	
1	Ownership (Gen/ISTS S/s Owner)	
2	Voltage level (220/400kV/Other)	
3	ISTS Substation from where connectivity granted	
4	Bay Number/s	

C. Communication Equipment details along with PMU

Sl. No.	Data Type	Gen End	ISTS S/s End	
		Installed /Provisioned	Scope (With Gen or ISTS S/s Owner)	Installed /Provisioned
1	Approach cable			
2	FODP			
3	PMU			
4	FOTE			

D. FOTE Details

Sl. No.	Particulars	Gen End	ISTS S/s end
1	Make		
2	Model		
3	Capacity (e.g. STM16)		
4	No. of supported optical directions (e.g. 5 MSP)		

Data format-IV

Details of the modification/alteration to existing facilities for accommodating proposed connection and its estimated cost

Data format -V

Communication Link details up to ISTS Data Collection Point

Requirement of Channels:

i. 2 Nos Data Channel (600Baud) /64 Kbps or Ethernet channel for RTU/SAS/DAS

ii. 1 No Speech channel

iii. 1 No. Data Channel (2 Mbps) for PMU

Data Collection Point for: Generating/Pooling Station Name

Data Collection Point (DCP): Name of ISTS Station

Wideband Link (Configuration of Data & Voice channel in wideband Link by Regional ULDC Team)**: -**

Channel: DCP Name- Respective RLDC

Data format-VI

Site responsibility schedule

A. Principle & Procedure:

The responsibility of control, operation, maintenance & all matters pertaining to safety of equipment's and apparatus at the connection point shall lie with the connectivity grantee. The grantee may enter into a separate O&M contract with the owner of the substation based on mutually agreed terms and conditions for ease of day-to-day O&M of the equipment which are located in the premises of the substation.

List of equipment and their ownership at the connection point:

Sl. No.	**Name of Equipment**	**Ownership**	
		Generation Switchyard / Pooling Station end	**ISTS Substation end at which Connectivity is granted**
1.	Circuit Breaker (with PIR /CSD if required))		
2.	Isolator (with no. of Earth Switch as required)		
3.	Disconnecting Switch(For GIS)		
4.	Maintenance Earthing Switch (For GIS)		
5.	High speed Earthing switch (For GIS)		
6.	CT		
7.	CT (Metering)		
8.	Line CVT		

Sl. No.	**Name of Equipment**	**Ownership**	
		Generation Switchyard / Pooling Station end	**ISTS Substation end at which Connectivity is granted**
9.	Bus CVT		
10.	PT (Metering)		
11.	Wave trap		
12.	Surge Arrester		
13.	ICT		
14.	Bus Reactor		
15.	Line Reactor		
16.	NGR		
17.	NCT		
18.	ESS (Energy Storage System)		
19.	Any other Equipment (….)		

Annexure-1

Basic System details

Sl. No.	Description	Values
1	System operating voltage	
2	Maximum voltage of the system (rms)	
3	Rated frequency	
4	Nos. of phases	
5	Rated insulation levels	
i.	Impulse withstand voltage for (1.25/50 micro second) - Transformer and Reactors - For other equipment - For insulator string	
ii.	Switching impulse withstand voltage (250/2500 micro second) dry and wet	
iii.	One-minute power frequency dry withstand voltage (rms)	
iv.	One-minute power frequency dry and wet withstand voltage (rms)	
6.	Corona extinction voltage	
7.	Max. radio interference voltage for frequency between 0.5MHz and 2MHz	
8.	Minimum creepage distance for insulator string/longrod insulators/ outdoor bushings	
9.	Minimum creepage distance for switchyard equipment	
10.	Max. fault current capacity (kA for …sec)	

Annexure-2

Data pertaining to interconnecting transmission line

A. Conductor		
i.	Name of conductor	
ii.	Outside diameter	
iii.	DC Resistance (ohm/km)	
iv.	Number of conductors in bundle	
v.	Bundle spacing (mm)	
vi.	Maximum operating Temperature (degree C)	
vii.	Ampacity at maximum operating Temperature (A) with calculation sheet as per IEEE 738 & CEA Technical standard/CEA Planning criteria)	
B. Earth Wire		
i.	Diameter of Earthwire	
ii.	DC Resistance (ohm/km)	
C. OPGW		
i.	OPGW diameter (mm)	
ii.	OPGW cross-section area (mm^2)	
iii.	Number of Strands	
iv.	Diameter of each strands	
v.	DC Resistance (Ohms/km)	
vi.	Short Circuit Current (kA)	
vii.	OPGW Sag - Tension chart	
viii.	Fiber type considered in OPGW	
ix.	No. of fibers available for use	
x.	Fiber loss (dB) Attenuation	

	Chromatic Dispersion	
xi.	FODP terminations capacity	
D. Communication Equipment		
i.	Transmission Equipment (SDH) capacity (STM4/16)	
ii.	Optical Directions supported	
iii.	Make and model of Transmission Equipment	
iv.	Ethernet card/ ports details and availability for use	

Annexure-3

1. Turbine Details (Thermal)

Category	Parameter Description	Data
Manufacturer of turbine	Manufacturer and name plate details Rating of turbine	
Type of Governor	Electro-mechanical governor	
	Digital electric governor	
	Block diagram of the speed governor	
Ramp rates	How fast can the turbine increase and/or decrease load, specified in MW/min	
	Stroke limits of speed changer (values of full stroke, full load and no-load in mm)	
Droop	Droop setting (% on machine base)	
	Frequency influence limiters - Maximum frequency deviation limiter (eg +/-2 Hz) - Maximum influence limiter (eg 10% of rating)	
Dead band	Details of frequency dead band (typically in Hz)	
Steam turbine	**Tandem compound**: all sections on one shaft with a single generator	
	Cross compound: consists of two shafts, each connected to a generator and driven by one or more turbine section	
	Turbine sections: High pressure (HP), intermediate pressure (IP) and low pressure (LP)	
	Reheat or non-reheat: In a reheat, steam upon leaving HP section returns to boiler where it passed through reheater before entering IP section	

Category	Parameter Description	Data
	Valves: - Main inlet stop valve (MSV) - Governor control valve (CV) - Reheater stop valve (RSV) - Intercept valves (IV)	
	Turbine control action: - Boiler follow mode - Turbine follow mode - Coordinated control	
	Fast valving /bypass operation	
	Block diagram of the turbine load control	
	Reheater volume (m^3), volume flow (kg/s), and average specific volume (m^3/kg)	

2. Turbine Details-Hydro (to be filled in for the HPP and PSP separately)

Category	Parameter Description	Data
Type of prime mover	Hydro-electric turbine Other (Pumped storage)	
Manufacturer of turbine	Manufacturer and name plate details	
Modes of operation	Type of modes of operation capable: - Generator - Pump storage - Synchronous condenser	
Governor	- Electro-mechanical governor (including settings and drawings) - Digital electric governor (including settings and drawings) - PID governor details and settings - Transient droop (dashpot) governor details and settings - Tacho-accelerometric governor details and settings - Input transducer details - Transfer function data	
	Digital electric governor	
Ramp rates	How fast can the turbine increase and/or decrease load, specified in MW/min Guide vane/wicket gate characteristic, including opening, closing rates/times and limits	
	Droop setting (% on machine base)	

Category	Parameter Description	Data
Droop	Frequency influence limiters - Maximum frequency deviation limiter (eg +/-2 Hz) - Maximum influence limiter (eg 10% of rating)	
Dead band	Details of frequency dead band (typically in Hz or RPM)	
Hydro-electric turbine	Type of hydro turbine Impulse turbines : typical with high head plants (Pelton wheel) Reaction turbine : typical with low and medium head plants (such as Francis and Kaplan turbine Head, water flow, velocity and pressure (e.g. intake and outtake/draft tube)	
Penstock	Length (m)	
	Area (m^2)	
	Internal penstock diameter	
	Pipe thickness, material or other characteristics (such as tapering)	
	Non-elastic or elastic	
	Linear or non-linear model (with or without relief valve) or Kaplan model	
	Flow of water through turbine (m^3/s) – with gates fully open	
	Number of penstocks supplied from common tunnel	
Pressure relief valve	Drawings/schematics	
	Settings	
	Operational descriptions	

Category	Parameter Description	Data
Surge tank, reservoir and tail water (i.e. head)	Vertical distance between the upper reservoir and level of turbine (in meters)	
	Head at turbine admission (lake head minus tailrace head) – (in meters)	
	Head loss due to friction in conduit (in meters)	
	Surge tank height, diameter and other characteristics (e.g. restricted inlet orifice)	
Pump characteristics	Active power draw vs head (table)	
	PSS status when pumping (on/off/not used)	
Synchronous condenser	Dewatered when operating as Syncon (yes/no)	
	Losses when operating as Syncon: • Mechanical loss (0 Mvar): …… MW • Copper loss (table) MW loss as a function of MVar output	
Other	Details of protection schemes that could influence dynamics (if any)	
	Details of resonance chamber for pipes (if any)	
	Temperature (e.g. water, ambient, unit)	
	Characteristic curve of blade versus gate (from 0MW to maximum MW)	

3. Turbine Details-Gas (to be filled in for the GT and ST separately)

Category	Parameter Description	Data
Type of prime mover	- Open cycle gas turbine - Aero-derivative (twin shaft) gas turbine - Combined cycle plant (closed cycle gas turbine)	
Manufacturer of turbine	Manufacturer and name plate details	
Governor	Electro-mechanical governor (including settings and drawings)	
	Digital electric governor (including settings and drawings)	
Ramp rates	How fast can the turbine increase and/or decrease load, specified in MW/min Guide vane/wicket gate characteristic, including opening, closing rates/times and limits	
Droop	Droop setting (% on machine base)	
	Frequency influence limiters - Maximum frequency deviation limiter (eg +/-2 Hz) - Maximum influence limiter (eg 10% of rating)	
Dead band	Details of frequency dead band (typically in Hz or RPM)	
Technology	- Open cycle - Close cycle	
Gas turbine	Does turbine operate in dual fuel (gas and liquid fuel)	
	Inlet guide vane (IGV) characteristic	
	Limit for exhaust gas temperature (EGT)	
	Base load/frequency control	
	Power output versus ambient temperature	
	No load fuel flow and turbine gain (determined by relationship of active power versus fuel valve position or fuel stroke reference)	
	Details on heat recovery steam generator (HRSG)	

Category	Parameter Description	Data
Combine cycle plant	- Block diagram - GT output vs heat relationship (look up table) - Drum time constant Pressure loss due to friction in boiler tubes	
	Size of steam turbine	
	Frequency control of ST	
	Time lag and relationship of GT and ST	
	Is the combined cycle plant a single shaft plant – i.e. the gas and steam turbine are on same shaft and drive same generator	

Annexure-4

Generic Models for synchronous machine

There are two typical groups of synchronous machine models, depending upon the type of machine:

- Round rotor machine (2 poles):
  - GENROU – Round rotor machine model with quadratic saturation function
  - GENROE – Round rotor machine model with exponential saturation function
- Salient pole machine (more than two poles):
  - GENSAL – Salient pole machine with quadratic saturation function
  - GENSAE – Salient pole machine with exponential saturation function

Category	Parameter Description	Data
GENERATOR model		
GENROU OR **GENROE**	Direct axis open circuit transient time constant T_{do}' in sec	
	Direct axis open circuit sub-transient time constant T_{do}'' in sec	
	Quadrature axis open circuit transient time constant T_{qo}' in sec	
	Quadrature axis open circuit sub-transient time constant T_{qo}'' in sec	
	Inertia constant of total rotating mass H in MW.s/MVA	
	Speed Damping D	
	Direct axis synchronous reactance X_d in p.u. (Unsaturated)	
	Quadrature axis synchronous reactance X_q in p.u. (Unsaturated)	
	Direct axis transient synchronous reactance X_d' in p.u.	

Category	Parameter Description	Data
GENERATOR model		
	(Unsaturated)	
	Quadrature axis transient synchronous reactance X_q' in p.u. (Unsaturated)	
	Direct axis sub-transient synchronous reactance X_d'' in p.u. (Unsaturated)	
	Quadrature axis sub-transient synchronous reactance X_q'' in p.u. (Unsaturated)	
	Stator leakage reactance X_l in p.u.	
	Saturation constant S1 (1.0) in p.u.	
	Saturation constant S2 (1.2) in p.u.	
GENSAE OR **GENSAL**	Direct axis open circuit transient time constant T_{do}' in sec	
	Direct axis open circuit sub-transient time constant T_{do}'' in sec	
	Quadrature axis open circuit sub-transient time constant T_{qo}'' in sec	
	Inertia constant of total rotating mass H in MW.s/MVA	
	Speed Damping D	
	Direct axis synchronous reactance X_d in p.u. (Unsaturated)	
	Quadrature axis synchronous reactance X_q in p.u. (Unsaturated)	
	Direct axis transient synchronous reactance X_d' in p.u. (Unsaturated)	
	Direct axis sub-transient synchronous reactance X_d'' in p.u. (Unsaturated) = Quadrature axis sub-transient synchronous reactance X_q'' in p.u. (Unsaturated)	

Category	Parameter Description	Data
GENERATOR model		
	Stator leakage reactance X_l in p.u.	
	Saturation constant S (1.0) in p.u.	
	Saturation constant S (1.2) in p.u.	

Category	Parameter Description	Data
DC Exciter		
ESDC1A OR ESDC2A	T_R regulator input filter time constant (sec)	
	K_A (> 0) (pu) voltage regulator gain	
	T_A (s), voltage regulator time constant	
	T_B (s), lag time constant	
	T_C (s), lead time constant	
	V_{RMAX} (pu) regulator output maximum limit or Zero	
	V_{RMIN} (pu) regulator output minimum limit	
	K_E (pu) exciter constant related to self-excited field	
	T_E (> 0) rotating exciter time constant (sec)	
	K_F (pu) rate feedback gain	
	T_{F1} (> 0) rate feedback time constant (sec)	
	Switch	
	E1, exciter flux at knee of curve (pu)	
	SE(E1), saturation factor at knee of curve	
	E2, maximum exciter flux (pu)	
	SE(E2), saturation factor at maximum exciter flux (pu)	
ESDC3A	T_R regulator input filter time constant (sec)	
	K_V (pu) limit on fast raise/lower contact setting	
	V_{RMAX} (pu) regulator output maximum limit or Zero	
	V_{RMIN} (pu) regulator output minimum limit	
	T_{RH} (> 0) Rheostat motor travel time (sec)	
	T_E (> 0) exciter time-constant (sec)	
	K_E (pu) exciter constant related to self-excited field	

Category	Parameter Description	Data
DC Exciter		
	V_{EMIN} (pu) exciter minimum limit	
	E1, exciter flux at knee of curve (pu)	
	SE(E1), saturation factor at knee of curve	
	E2, maximum exciter flux (pu)	
	SE(E2), saturation factor at maximum exciter flux (pu)	
ESDC4B	T_R regulator input filter time constant (sec)	
	K_P (pu) (> 0) voltage regulator proportional gain	
	K_I (pu) voltage regulator integral gain	
	K_D (pu) voltage regulator derivative gain	
	T_D voltage regulator derivative channel time constant (sec)	
	V_{RMAX} (pu) regulator output maximum limit	
	V_{RMIN} (pu) regulator output minimum limit	
	K_A (> 0) (pu) voltage regulator gain	
	T_A voltage regulator time constant (sec)	
	K_E (pu) exciter constant related to self-excited field	
	T_E (> 0) rotating exciter time constant (sec)	
	K_F (pu) rate feedback gain	
	T_F (> 0) rate feedback time constant (sec)	
	V_{EMIN} (pu) minimum exciter voltage output	
	E1, exciter flux at knee of curve (pu)	
	SE(E1), saturation factor at knee of curve	
	E2, maximum exciter flux (pu)	
	SE(E2), saturation factor at maximum exciter flux (pu)	

Category	Parameter Description	Data
AC Exciter		
ESAC1A	T_R regulator input filter time constant (sec)	
	T_B (s), lag time constant	
	T_C (s), lead time constant	
	K_A (> 0) (pu) voltage regulator gain	
	T_A (s), voltage regulator time constant	
	V_{AMAX} (pu) regulator output maximum limit	
	V_{AMIN} (pu) regulator output minimum limit	
	T_E (> 0) rotating exciter time constant (sec)	
	K_F (pu) rate feedback gain	
	T_F (> 0) rate feedback time constant (sec)	
	K_C (pu) rectifier loading factor proportional to commutating reactance	
	K_D (pu) demagnetizing factor, function of AC exciter reactances	
	K_E (pu) exciter constant related to self-excited field	
	E1, exciter flux at knee of curve (pu)	
	SE(E1), saturation factor at knee of curve	
	E2, maximum exciter flux (pu)	
	SE(E2), saturation factor at maximum exciter flux (pu)	
	V_{RMAX} (pu) regulator output maximum limit	
	V_{RMIN} (pu) regulator output minimum limit	
ESAC2A	T_R regulator input filter time constant (sec)	
	T_B (s), lag time constant	
	T_C (s), lead time constant	

Category	Parameter Description	Data
AC Exciter		
	K_A (> 0) (pu) voltage regulator gain	
	T_A (s), voltage regulator time constant	
	V_{AMAX} (pu) regulator output maximum limit	
	V_{AMIN} (pu) regulator output minimum limit	
	K_B, Second stage regulator gain	
	V_{RMAX} (pu) regulator output maximum limit	
	V_{RMIN} (pu) regulator output minimum limit	
	T_E (> 0) rotating exciter time constant (sec)	
	V_{FEMAX}, parameter of VEMAX, exciter field maximum output	
	K_H, Exciter field current feedback gain	
	K_F (pu) rate feedback gain	
	T_F (> 0) rate feedback time constant (sec)	
	K_C (pu) rectifier loading factor proportional to commutating reactance	
	K_D (pu) demagnetizing factor, function of AC exciter reactances	
	K_E (pu) exciter constant related to self-excited field	
	E1, exciter flux at knee of curve (pu)	
	SE(E1), saturation factor at knee of curve	
	E2, maximum exciter flux (pu)	
	SE(E2), saturation factor at maximum exciter flux (pu)	
	T_R regulator input filter time constant (sec)	
	T_B (s), lag time constant	

Category	Parameter Description	Data
AC Exciter		
ESAC3A	T_C (s), lead time constant	
	K_A (> 0) (pu) voltage regulator gain	
	T_A (s), voltage regulator time constant	
	V_{AMAX} (pu) regulator output maximum limit	
	V_{AMIN} (pu) regulator output minimum limit	
	T_E (> 0) rotating exciter time constant (sec)	
	V_{EMIN} (pu) minimum exciter voltage output	
	K_R (>0), Constant associated with regulator and alternator field power supply	
	K_F (pu) rate feedback gain	
	T_F (> 0) rate feedback time constant (sec)	
	K_N, Exciter feedback gain	
	EFDN, A parameter defining for which value of UF the feedback gain shall change from KF to KN	
	K_C, rectifier regulation factor (pu)	
	K_D, exciter regulation factor (pu)	
	K_E (pu) exciter constant related to self-excited field	
	V_{FEMAX}, parameter of VEMAX, exciter field maximum output	
	E1, exciter flux at knee of curve (pu)	
	SE(E1), saturation factor at knee of curve	
	E2, maximum exciter flux (pu)	
	SE(E2), saturation factor at maximum exciter flux (pu)	
	T_R regulator input filter time constant (sec)	

Category	Parameter Description	Data
AC Exciter		
ESAC4A	V_{IMAX}, Maximum value of limitation of the integrator signal V_I in p.u	
	V_{IMIN}, Minimum value of limitation of the signal VI in p.u.	
	T_B (s), lag time constant	
	T_C (s), lead time constant	
	K_A (> 0) (pu) voltage regulator gain	
	T_A (s), voltage regulator time constant	
	V_{RMAX} (pu) regulator output maximum limit	
	V_{RMIN} (pu) regulator output minimum limit	
	K_C, rectifier regulation factor (pu)	
ESAC5A	T_R regulator input filter time constant (sec)	
	K_A (> 0) (pu) voltage regulator gain	
	T_A (s), voltage regulator time constant	
	V_{RMAX} (pu) regulator output maximum limit	
	V_{RMIN} (pu) regulator output minimum limit	
	K_E (pu) exciter constant related to self-excited field	
	T_E (> 0) rotating exciter time constant (sec)	
	K_F (pu) rate feedback gain	
	T_{F1} (sec), Regulator stabilizing circuit time constant in seconds	
	T_{F2} (sec), Regulator stabilizing circuit time constant in seconds	
	T_{F3} (sec), Regulator stabilizing circuit time constant in seconds	

Category	Parameter Description	Data
AC Exciter		
	E1, exciter flux at knee of curve (pu)	
	SE(E1), saturation factor at knee of curve	
	E2, maximum exciter flux (pu)	
	SE(E2), saturation factor at maximum exciter flux (pu)	
AC6A	T_R regulator input filter time constant (sec)	
	K_A (> 0) (pu) voltage regulator gain	
	T_A (s), voltage regulator time constant	
	T_K (sec), Lead time constant	
	T_B (s), lag time constant	
	T_C (s), lead time constant	
	V_{AMAX} (pu) regulator output maximum limit	
	V_{AMIN} (pu) regulator output minimum limit	
	V_{RMAX} (pu) regulator output maximum limit	
	V_{RMIN} (pu) regulator output minimum limit	
	T_E (> 0) rotating exciter time constant (sec)	
	VFELIM, Exciter field current limit reference	
	K_H, Damping module gain	
	V_{HMAX}, damping module limiter	
	T_H (sec), damping module lag time constant	
	T_J (sec), damping module lead time constant	
	K_C, rectifier regulation factor (pu)	
	K_D, exciter regulation factor (pu)	
	K_E (pu) exciter constant related to self-excited field	

Category	Parameter Description	Data
AC Exciter		
	E1, exciter flux at knee of curve (pu)	
	SE(E1), saturation factor at knee of curve	
	E2, maximum exciter flux (pu)	
	SE(E2), saturation factor at maximum exciter flux (pu)	
AC7B	T_R (sec) regulator input filter time constant	
	K_{PR} (pu) regulator proportional gain	
	K_{IR} (pu) regulator integral gain	
	K_{DR} (pu) regulator derivative gain	
	T_{DR} (sec) regulator derivative block time constant	
	V_{RMAX} (pu) regulator output maximum limit	
	V_{RMIN} (pu) regulator output minimum limit	
	K_{PA} (pu) voltage regulator proportional gain	
	K_{IA} (pu) voltage regulator integral gain	
	V_{AMAX} (pu) regulator output maximum limit	
	V_{AMIN} (pu) regulator output minimum limit	
	K_P (pu)	
	K_L (pu)	
	K_{F1} (pu)	
	K_{F2} (pu)	
	K_{F3} (pu)	
	T_{F3} (sec) time constant (> 0)	
	K_C (pu) rectifier loading factor proportional to commutating reactance	
	K_D (pu) demagnetizing factor, function of AC exciter	

Category	Parameter Description	Data
AC Exciter		
	reactances	
	K_E (pu) exciter constant related fo self-excited field	
	T_E (pu) exciter time constant (>0)	
	V_{FEMAX} (pu) exciter field current limit (> 0)	
	V_{EMIN} (pu)	
	E1, exciter flux at knee of curve (pu)	
	SE(E1), saturation factor at knee of curve	
	E2, maximum exciter flux (pu)	
	SE(E2), saturation factor at maximum exciter flux (pu)	
AC8B	T_R (sec) regulator input filter time constant	
	K_{PR} (pu) regulator proportional gain	
	K_{IR} (pu) regulator integral gain	
	K_{DR} (pu) regulator derivative gain	
	T_{DR} (sec) regulator derivative block time constant	
	$VPID_{MAX}$ (pu) PID maximum limit	
	$VPID_{MIN}$ (pu) PID minimum limit	
	K_A (pu) voltage regulator proportional gain	
	T_A (sec) voltage regulator time constant	
	V_{RMAX} (pu) regulator output maximum limit	
	V_{RMIN} (pu) regulator output minimum limit	
	K_C (pu) rectifier loading factor proportional to commutating reactance	
	K_D (pu) demagnetizing factor, function of AC exciter reactances	

Category	Parameter Description	Data
AC Exciter		
	K_E (pu) exciter constant related fo self-excited field	
	T_E (pu) exciter time constant (>0)	
	V_{FEMAX} (pu) max exciter field current limit (> 0)	
	V_{EMIN} (pu),	
	E1, exciter flux at knee of curve (pu)	
	SE(E1), saturation factor at knee of curve	
	E2, maximum exciter flux (pu)	
	SE(E2), saturation factor at maximum exciter flux (pu)	

Category	Parameter Description	Data
Static Exciter		
ST1A	T_R (sec) regulator input filter time constant	
	V_{IMAX}, Controller Input Maximum	
	V_{IMIN}, Controller Input Minimum	
	T_C (s), Filter 1st Derivative Time Constant	
	T_B (s), l Filter 1st Delay Time Constant	
	T_{C1} (s), Filter 2nd Derivative Time Constant	
	T_{B1} (s), Filter 2nd Delay Time Constant	
	K_A (pu) voltage regulator proportional gain	
	T_A (sec) voltage regulator time constant	
	V_{AMAX} (pu) regulator output maximum limit	
	V_{AMIN} (pu) regulator output minimum limit	
	V_{RMAX} (pu) regulator output maximum limit	
	V_{RMIN} (pu) regulator output minimum limit	
	K_C (pu) rectifier loading factor proportional to commutating reactance	
	K_F (pu) rate feedback gain	
	T_F (> 0) rate feedback time constant (sec)	
	K_{LR}, Current Input Factor	
	I_{LR}, Current Input Reference	
	T_R (sec) regulator input filter time constant	
	K_A (pu) voltage regulator proportional gain	
	T_A (sec) voltage regulator time constant	
	V_{RMAX} (pu) regulator output maximum limit	

Category	Parameter Description	Data
Static Exciter		
ST2A	V_{RMIN} (pu) regulator output minimum limit	
	K_E (pu) exciter constant related fo self-excited field	
	T_E (pu) exciter time constant (>0)	
	K_F (pu) rate feedback gain	
	T_F (> 0) rate feedback time constant (sec)	
	K_P (pu) voltage regulator proportional gain	
	K_I (pu) voltage regulator integral gain	
	K_C (pu) rectifier loading factor proportional to commutating reactance	
	EFDMAX	
ST3A	T_R (sec) regulator input filter time constant	
	V_{IMAX}, Maximum value of limitation of the signal VI in p.u.	
	V_{IMIN}, Minimum value of limitation of the signal VI in p.u.	
	K_M, Forward gain constant of the inner loop field regulator	
	T_C (s), lag time constant	
	T_B (s), lead time constant	
	K_A (pu) voltage regulator proportional gain	
	T_A (sec) voltage regulator time constant	
	V_{RMAX} (pu) regulator output maximum limit	
	V_{RMIN} (pu) regulator output minimum limit	
	K_G, Feedback gain constant of the inner loop field regulator	
	K_P (pu) voltage regulator proportional gain	
	K_I (pu) voltage regulator integral gain	

Category	Parameter Description	Data
Static Exciter		
	V_{BMAX}, Maximum value of limitation of the signal VB in p.u.	
	K_C (pu) rectifier loading factor proportional to commutating reactance	
	X_L, Reactance associated with potential source	
	V_{GMAX}, Maximum value of limitation of the signal VG in p.u	
	Θ_P (degrees)	
	T_M (sec), Forward time constant of the inner loop field regulator	
	V_{MMAX}, Maximum value of limitation of the signal VM in p.u	
	V_{MMIN}, Minimum value of limitation of the signal VM in p.u.	
ST4B	T_R (sec) regulator input filter time constant	
	K_{PR} (pu) regulator proportional gain	
	K_{IR} (pu) regulator integral gain	
	V_{RMAX} (pu) regulator output maximum limit	
	V_{RMIN} (pu) regulator output minimum limit	
	T_A (sec) voltage regulator time constant	
	K_{PM}, Regulator gain	
	K_{IM}, Regulator gain	
	V_{MMAX}, Maximum value of limitation of the signal in p.u.	
	V_{MMIN}, Minimum value of limitation of the signal in p.u.	
	K_G	
	K_P (pu) voltage regulator proportional gain	
	K_I (pu) voltage regulator integral gain	

Category	Parameter Description	Data
Static Exciter		
	VBMAX	
	K_C (pu) rectifier loading factor proportional to commutating reactance	
	X_L	
	Θ_P (degrees)	
ST5B	T_R regulator input filter time constant (sec)	
	T_{C1} lead time constant of first lead-lag block (voltage regulator channel) (sec)	
	T_{B1} lag time constant of first lead-lag block (voltage regulator channel) (sec)	
	T_{C2} lead time constant of second lead-lag block (voltage regulator channel) (sec)	
	T_{B2} lag time constant of second lead-lag block (voltage regulator channel) (sec)	
	K_R (>0) (pu) voltage regulator gain	
	V_{RMAX} (pu) voltage regulator maximum limit	
	V_{RMIN} (pu) voltage regulator minimum limit	
	T_1 voltage regulator time constant (sec)	
	K_C (pu)	
	TUC1 lead time constant of first lead-lag block (under-excitation channel) (sec)	
	TUB1 lag time constant of first lead-lag block (under-excitation channel) (sec)	
	TUC2 lead time constant of second lead-lag block (under-excitation channel) (sec)	

Category	Parameter Description	Data
Static Exciter		
	TUB2 lag time constant of second lead-lag block (under-excitation channel) (sec)	
	TOC1 lead time constant of first lead-lag block (over-excitation channel) (sec)	
	TOB1 lag time constant of first lead-lag block (over-excitation channel) (sec)	
	TOC2 lead time constant of second lead-lag block (over-excitation channel) (sec)	
	TOB2 lag time constant of second lead-lag block (over-excitation channel) (sec)	
ST6B	TR regulator input filter time constant (sec)	
	KPA (pu) (> 0) voltage regulator proportional gain	
	KIA (pu) voltage regulator integral gain	
	KDA (pu) voltage regulator derivative gain	
	TDA voltage regulator derivative channel time constant (sec)	
	VAMAX (pu) regulator output maximum limit	
	VAMIN (pu) regulator output minimum limit	
	KFF (pu) pre-control gain of the inner loop field regulator	
	KM (pu) forward gain of the inner loop field regulator	
	KCI (pu) exciter output current limit adjustment gain	
	KLR (pu) exciter output current limiter gain	
	ILR (pu) exciter current limit reference	
	VRMAX (pu) voltage regulator output maximum limit	

Category	Parameter Description	Data
Static Exciter		
	VRMIN (pu) voltage regulator output minimum limit	
	KG (pu) feedback gain of the inner loop field voltage regulator	
	TG (> 0) feedback time constant of the inner loop field voltage regulator (sec)	
ST7B	TR regulator input filter time constant (sec)	
	TG lead time constant of voltage input (sec)	
	TF lag time constant of voltage input (sec)	
	Vmax (pu) voltage reference maximum limit	
	Vmin (pu) voltage reference minimum limit	
	KPA (pu) (>0) voltage regulator gain	
	VRMAX (pu) voltage regulator output maximum limit	
	VRMIN (pu) voltage regulator output minimum limit	
	KH (pu) feedback gain	
	KL (pu) feedback gain	
	TC lead time constant of voltage regulator (sec)	
	TB lag time constant of voltage regulator (sec)	
	KIA (pu) (>0) gain of the first order feedback block	
	TIA (>0) time constant of the first order feedback block (sec)	

Category	Parameter Description	Data
Stabilizer Model		
PSS1A	A_1, Filter coefficient	
	A_2, Filter coefficient	
	T_R, transducer time constant	
	T_1, 1st Lead-Lag Derivative Time Constant	
	T_2, 1st Lead-Lag Delay Time Constant	
	T_3, 2nd Lead-Lag Derivative Time Constant	
	T_4, 2nd Lead-Lag Delay Time Constant	
	T_w, Washout Time Constant	
	T_w, Washout Time Constant	
	Ks, input channel gain	
	V_{STMAX}, Controller maximum output	
	V_{STMAX}, Controller minimum output	
PSS2B	T_{W1}, 1st Washout 1th Time Constant	
	T_{W2}, 1st Washout 2th Time Constant	
	T_6, 1st Signal Transducer Time Constant	
	T_{W3}, 2nd Washout 1th Time Constant	
	T_{W4}, 2nd Washout 2th Time Constant	
	T_7, 2nd Signal Transducer Time Constant	
	K_{S2}, 2nd Signal Transducer Factor	
	K_{S3}, Washouts Coupling Factor	
	T_8, Ramp Tracking Filter Deriv. Time Constant	
	T_9, Ramp Tracking Filter Delay Time Constant	
	K_{S1}, PSS Gain	

Category	Parameter Description	Data
Stabilizer Model		
	T_1, 1st Lead-Lag Derivative Time Constant	
	T_2, 1st Lead-Lag Delay Time Constant	
	T_3, 2nd Lead-Lag Derivative Time Constant	
	T_4, 2nd Lead-Lag Delay Time Constant	
	T_{10}, 3rd Lead-Lag Derivative Time Constant	
	T_{11}, 3rd Lead-Lag Delay Time Constant	
	V_{S1MAX}, Input 1 Maximum limit	
	V_{S1MIN}, Input 1 Minimum limit	
	V_{S2MAX}, Input 2 Maximum limit	
	V_{S2MIN}, Input 2 Minimum limit	
	V_{STMAX}, Controller Maximum Output	
	V_{STMIN}, Controller Minimum Output	
PSS3B	K_{S1} (pu) (≠0), input channel #1 gain	
	T_1 input channel #1 transducer time constant (sec)	
	T_{w1} input channel #1 washout time constant (sec)	
	K_{S2} (pu) , input channel #2 gain	
	T_2 input channel #2 transducer time constant (sec)	
	T_{w2} input channel #2 washout time constant (sec)	
	T_{w3} (0), main washout time constant (sec)	
	A_1, Filter coefficient	
	A_2, Filter coefficient	
	A_3, Filter coefficient	
	A_4, Filter coefficient	

Category	Parameter Description	Data
Stabilizer Model		
	A_5, Filter coefficient	
	A_6, Filter coefficient	
	A_7, Filter coefficient	
	A_8, Filter coefficient	
	V_{STMAX}, Controller maximum output	
	V_{STMAX}, Controller minimum output	

Category	Parameter Description	Data
Turbine Governor model		
BBGOV1	fcut (>=0) (pu), cut off frequency	
	K_S, frequency gain	
	K_{LS} (> 0)	
	K_G	
	K_P, power regulator gain	
	T_N (sec) (> 0)	
	K_D, damping gain	
	T_D (sec) (> 0), damping time constant	
	T_4 (sec), high pressure time constant	
	K_2, intermediate pressure time constant	
	T_5 (sec), intermediate re-heater time constant	
	K_3, high pressure time constant	
	T_6 (sec), re-heater time constant	
	T_1 (sec), measuring transducer time constant	
	SWITCH	
	P_{MAX}, maximum power output limiter	
	P_{MIN}, minimum power output limiter	
TGOV1	R, Permanent Droop	
	T1 (>0) (sec), Steam bowl time constant	
	V_{MAX}, Maximum valve position	
	V_{MIN}, Minimum valve position	
	T2 (sec), Time constant	
	T3 (>0) (sec), reheater time constant	

Category	Parameter Description	Data
Turbine Governor model		
	Dt, Turbine damping coefficient	
	V_{MAX}, V_{MIN}, D_t and R are in per unit on generator MVA base. T2/T3 = high-pressure fraction.	
CRCMGV	P_{MAX} (HP)1, maximum HP value position (on generator base)	
	R (HP), HP governor droop	
	T1 (HP) (>0), HP governor time constant	
	T3 (HP) (>0), HP turbine time constant	
	T4 (HP) (>0), HP turbine time constant	
	T5 (HP) (>0), HP reheater time constant	
	F (HP), fraction of HP power ahead of reheater	
	DH (HP), HP damping factor (on generator base)	
	P_{MAX} (LP), maximum LP value position (on generator base)	
	R (LP), LP governor droop	
	T1 (LP) (>0), LP governor time constant	
	T3 (LP) (>0), LP turbine time constant	
	T4 (LP) (>0), LP turbine time constant	
	T5 (LP) (>0), LP turbine time constant	
	F (LP), fraction of LP power ahead of reheater	
	DH (LP), LP damping factor (on generator base)	
	K, Governor gain, (1/droop) pu	
	T1 (sec), Lag time constant (sec)	
	T2 (sec), Lead time constant (sec)	
	T3 (> 0) (sec), valve position time constant	
	Uo (pu/sec), maximum valve opening rate	

Category	Parameter Description	Data
Turbine Governor model		
IEEEG1	Uc (< 0) (pu/sec), maximum valve closing rate	
	P_{MAX} (pu on machine MVA rating)	
	P_{MIN} (pu on machine MVA rating)	
	T4 (sec), time constant for steam inlet	
	K1, HP fraction	
	K2, LP fraction	
	T5 (sec), Time Constant for Second Boiler Pass [s]	
	K3, HP Fraction	
	K4, LP fraction	
	T6 (sec), Time Constant for Third Boiler Pass [s]	
	K5, HP Fraction	
	K6, LP fraction	
	T7 (sec), Time Constant for Fourth Boiler Pass [s]	
	K7, HP Fraction	
	K8, LP fraction	
IEEEG2	K, Governor gain	
	T1 (sec), Governor lag time constant	
	T2 (sec), Governor lead time constant	
	T3 (>0) (sec), Gate actuator time constant	
	P_{MAX} (pu on machine MVA rating), gate maximum	
	P_{MIN} (pu on machine MVA rating), gate minimum	
	T4 (>0) (sec), water starting time	
	T_G, (>0) (sec), gate servomotor time constant	

Category	Parameter Description	Data
Turbine Governor model		
IEEEG3	T_P (>0) (sec), pilot value time constant	
	Uo (pu per sec), opening gate rate limit	
	Uc (pu per sec), closing gate rate limit (< 0)	
	P_{MAX} maximum gate position (pu on machine MVA rating)	
	P_{MIN} minimum gate position (pu on machine MVA rating)	
	σ, permanent speed droop coefficient	
	δ, transient speed droop coefficient	
	T_R, (>0) (sec), Dashpot time constant	
	T_W (>0) (sec), water starting time	
	a11 (>0), Turbine coefficient	
	a13, Turbine coefficient	
	a21, Turbine coefficient	
	a23 (>0), Turbine coefficient	
IEESGO	T1, Controller Lag	
	T2, Controller Lead Compensation	
	T3, Governor Lag (> 0)	
	T4, Delay Due To Steam Inlet Volumes	
	T5, Reheater Delay	
	T6, Turbine, pipe, hood Delay	
	K1, 1/Per Unit Regulation	
	K2, Fraction	
	K3, fraction	
	P_{MAX}, Upper Power Limit	

Category	Parameter Description	Data
Turbine Governor model		
	P_{MIN}, Lower Power Limit	
TGOV2	R (pu), permanent droop	
	T1 (>0) (sec), Steam bowl time constant	
	V_{MAX} (pu), Maximum valve position	
	V_{MIN} (pu), Minimum valve position	
	K (pu), Governor gain	
	T3 (>0) (sec), Time constant	
	Dt (pu), Turbine damping coefficient	
	Tt (>0) (sec), Valve time constant	
	T_A, Valve position at time 2 (fully closed after fast valving initialization)	
	T_B, Valve position at time 3 (start to reopen after fast valving initialization)	
	T_C, Valve position at time 4 (again fully open after fast valving initializations)	
TGOV3	K, Governor gain	
	T1 (sec), Governor lead time constant	
	T2 (sec), Governor lag time constant	
	T3 (>0) (sec), Valve positioner time constant	
	Uo, Maximum valve opening velocity	
	Uc (< 0), Maximum valve closing velocity	
	P_{MAX}, Maximum valve opening	
	P_{MIN}, Minimum valve opening	
	T4 (sec), Inlet piping/steam bowl time constant	

Category	Parameter Description	Data
Turbine Governor model		
	K1, Fraction of turbine power developed after first boiler pass	
	T5 (> 0) (sec), Time constant of second boiler pass	
	K2, Fraction of turbine power developed after second boiler pass	
	T6 (sec), Time constant of crossover or third boiler pass	
	K3, Fraction of hp turbine power developed after crossover or third boiler pass	
	TA (sec), Valve position at time 2 (fully closed after fast valving initializations)	
	TB (sec), Valve position at time 3 (start to reopen after fast valving initializations)	
	TC (sec), Valve position at time 4 (again fully open after fast valving initializations)	
	PRMAX (pu), Max. pressure in reheater	
	K, The inverse of the governor speed droop	
	T1 (sec), The governor controller lag time constant	
	T2 (sec), The governor controller lead time constant	
	T3 (>0) (sec), The valve servomotor time constant for the control valves	
	Uo, The control valve open rate limit	
	Uc (<0), The control valve close rate limit	
	KCAL	
	T4 (sec), The steam flow time constant	
	K1	
	T5 (> 0) (sec)	

Category	Parameter Description	Data
Turbine Governor model		
TGOV4	K2	
	T6 (sec)	
	P_{RMAX}	
	KP	
	KI	
	TFuel (sec)	
	TFD1 (sec)	
	TFD2 (sec)	
	Kb	
	Cb (> 0) (sec)	
	TIV (> 0) (sec)	
	UOIV	
	UCIV	
	R (>0)	
	Offset	
	CV position demand characteristic	
	CV #2 offset	
	CV #3 offset	
	CV #4 offset	
	IV position demand characteristic	
	IV #2 offset	
	CV valve characteristic	
	IV valve characteristic	

Category	Parameter Description	Data
Turbine Governor model		
	CV starting time for valve closing (sec)	
	CV closing rate (pu/sec)	
	Time closed for CV #1 (sec)	
	Time closed for CV #2	
	Time closed for CV #3	
	Time closed for CV #4	
	IV starting time for valve closing (sec)	
	IV closing rate (pu/sec)	
	Time closed for IV #1 (sec)	
	Time closed for IV #2 (sec)	
	TRPLU (>0) (sec)	
	PLU rate level	
	Timer	
	PLU unbalance level	
	TREVA (>0) (sec)	
	EVA rate level	
	EVA unbalance level	
	Minimum load reference (pu)	
	Load reference ramp rate (pu/sec)	
	K, The inverse of the governor speed droop	
	T1 (sec), The governor controller lag time constant	
	T2 (sec), The governor controller lead time constant	
	T3 (>0) (sec), The valve servomotor time constant for the control valves	

Category	Parameter Description	Data
Turbine Governor model		
TGOV5	Uo, The control valve open rate limit	
	Uc (<0), The control valve close rate limit	
	V_{MAX}, The maximum valve area	
	V_{MIN}, The minimum valve area	
	T4 (sec), The steam flow time constant	
	K1, The fractions of the HP	
	K2, fractions of the LP	
	T5 (sec), The first reheater time constant	
	K3, The fractions of the HP	
	K4, fractions of the LP	
	T6 (sec), second reheater time constant	
	K5, The fractions of the HP	
	K6, fractions of the LP	
	T7 (sec), crossover time constant	
	K7, The fractions of the HP	
	K8, fractions of the LP	
	K9, The adjustment to the pressure drop coefficient as a function of drum pressure	
	K10, The gain of anticipation signal from main stream flow	
	K11, The gain of anticipation signal from load demand	
	K12, The gain for pressure error bias	
	K13, The gain between MW demand and pressure set point	
	K14, Inverse of load reference servomotor time constant (= 0.0 if load reference does not change).	

Category	Parameter Description	Data
Turbine Governor model		
	R_{MAX}, The load reference positive rate of change limit	
	R_{MIN}, The load reference negative rate of change limit	
	L_{MAX}, The maximum load reference	
	L_{MIN}, The minimum load reference	
	C1, The pressure drop coefficient	
	C2, The gain for the pressure error bias	
	C3, The adjustment to the pressure set point	
	B, The frequency bias for load reference control	
	CB (>0) (sec), The boiler storage time constant	
	KI, The controller integral gain	
	TI (sec), The controller proportional lead time constant	
	T_R (sec), The controller rate lead time constant	
	T_{R1} (sec), The inherent lag associated with lead TR (usually about TR/10)	
	C_{MAX}, The maximum controller output	
	C_{MIN}, The minimum controller output	
	T_D (sec), The time delay in the fuel supply system	
	T_F (sec), The fuel and air system time constant	
	TW (sec), The water wall time constant	
	Psp (initial) (>0), The initial throttle pressure set point	
	TMW (sec), The MW transducer time constant	
	KL (0.0 or 1.0), The feedback gain from the load reference	
	KMW (0.0 or 1.0), The gain of the MW transducer	
	DPE (pu pressure), The dead band in the pressure error signal	

Category	Parameter Description	Data
Turbine Governor model		
	for load reference control	
	• The fractions of the HP unit's mechanical power developed by the various turbine stages. The sum of K1, K3, K5 and K7 constants should be one for a non cross-compound unit. • Similarly fractions of the LP unit's mechanical power should be zero for a non cross- compound unit. For a cross-compound unit, the sum of K1 through K8 should equal one.	
TURCZT	f_{DEAD} (pu), Frequency Dead Band	
	f_{MIN} (pu), Frequency Minimum Deviation	
	f_{MAX} (pu), Frequency Maximum Deviation	
	KKOR (pu), Frequency Gain	
	K_M > 0 (pu), Power Measurement Gain	
	K_P (pu), Regulator Proportional Gain	
	S_{DEAD} (pu), Speed Dead Band	
	K_{STAT} (pu), Speed Gain	
	KHP (pu), High Pressure Constant	
	T_C (sec), Measuring transducer time constant	
	T 1 (sec), Regulator Integrator Time Constant	
	TEHP (sec), Hydro Converter Time Constant	
	TV > 0 (sec), Regulation Valve Time Constant	
	THP (sec), High Pressure Time Constant	
	T_R (sec), Reheater time constant	
	TW (sec), Water Time Constant	
	NT_{MAX} (pu), Power Regulator-Integrator Maximum Limiter	

Category	Parameter Description	Data
Turbine Governor model		
	NT_{MIN} (pu), Power Regulator-Integrator Minimum Limiter	
	G_{MAX} (pu), Valve Maximum Open	
	G_{MIN} (pu), Valve Minimum Open	
	V_{MIN} (pu/sec), Valve Maximum Speed Close	
	V_{MAX} (pu/sec), Valve Maximum Speed Open	
HYGOV	R, permanent droop	
	r, temporary droop	
	T_r (>0) governor time constant	
	T_f (>0) filter time constant	
	T_g (>0) servo time constant	
	+ VELM, gate velocity limit	
	G_{MAX}, maximum gate limit	
	G_{MIN}, minimum gate limit	
	TW (>0) water time constant	
	At, turbine gain	
	Dturb, turbine damping	
	qNL, no power flow	
	R, permanent droop	
	r, temporary droop	
	Tr (>0) governor time constant	
	Tf (>0) filter time constant	
	Tg (>0) servo time constant	
	+ VELM, gate velocity limit	

Category	Parameter Description	Data
Turbine Governor model		
HYGOVDU	G_{MAX}, maximum gate limit	
	G_{MIN}, minimum gate limit	
	TW (>0) water time constant	
	At, turbine gain	
	Dturb, turbine damping	
	qNL, no power flow	
	DBH (pu), droop for over-speed, (> 0)	
	DBL (pu), droop for under-speed, (< 0)	
	TRate (MW), turbine rating, if zero, then MBASE used	
	P_{rated}, rated turbine power (MW	
	Q_{rated}, rated turbine flow (cfs or cms)	
	H_{rated}, rated turbine head (ft or m)	
	G_{rated}, gate position at rated conditions (pu)	
	QNL, no power flow (pu of Qrated)	
	R, permanent droop (pu)	
	r, temporary droop (pu)	
	Tr, governor time constant (> 0) (sec)	
	Tf, filter time constant (> 0) (sec)	
	Tg, servo time constant (> 0) (sec)	
	MXGTOR, maximum gate opening rate (pu/sec)	
	MXGTCR, maximum gate closing rate (< 0) (pu/sec)	
	MXBGOR, maximum buffered gate opening rate (pu/sec)	
	MXBGCR, maximum buffered gate closing rate (< 0) (pu/sec)	

Category	Parameter Description	Data
Turbine Governor model		
HYGOVM	BUFLIM, buffer upper limit (pu)	
	GMAX, maximum gate limit (pu)	
	GMIN, minimum gate limit (pu)	
	RVLVCR, relief valve closing rate (< 0) (pu/sec) or MXJDOR, maximum jet deflector opening rate (pu/sec)	
	RVLMAX, maximum relief valve limit (pu) or MXJDCR, maximum jet deflector closing rate (< 0) (pu/sec)	
	HLAKE, lake head (ft or m)	
	HTAIL, tail head (ft or m)	
	PENL/A, summation of penstock, scroll case and draft tube lengths/ cross sections (> 0)(1/ft or 1/m)	
	PENLOS, penstock head loss coefficient (ft/cfs2 or m/cms2)	
	TUNL/A, summation of tunnel lengths/cross sections (>0) (1/ft or 1/m)	
	TUNLOS, tunnel head loss coefficient (ft/cfs^2 or m/cms^2)	
	SCHARE, surge chamber effective cross section (>0) (ft^2 or m^2)	
	SCHMAX, maximum water level in surge chamber (ft or m)	
	SCHMIN, minimum water level in surge chamber (ft or m)	
	SCHLOS, surge chamber orifice head loss coefficient (ft/cfs^2 or m/cms^2)	
	DAMP1, turbine damping under RPM1	
	RPM1, over speed (pu)	
	DAMP2, turbine damping above RPM2	
	RPM2, over speed (pu)	
	R-PERM-GATE (Feedback settings)	

Category	Parameter Description	Data
Turbine Governor model		
WEHGOV	R-PERM-PE (Feedback settings)	
	TPE (sec), Power time constant	
	Kp, Proportional gain	
	KI, Integral gain	
	KD, Derivative gain	
	TD (sec), Derivative time constant	
	TP (sec), Gate servo time constant	
	TDV (sec), Time constant	
	Tg (sec), Gate servo time constant	
	GTMXOP (>0), Max gate opening velocity	
	GTMXCL (<0), Max gate closing velocity	
	GMAX, Maximum governor output	
	GMIN, Minimum governor output	
	DTURB, Turbine damping factor	
	TW (sec), Water inertia time constant	
	Speed Dead Band (DBAND)	
	DPV, Governor limit factor	
	DICN, Gate limiter modifier	
	GATE 1	
	GATE 2	
	GATE 3	
	GATE 4	
	GATE 5	

Category	Parameter Description	Data
Turbine Governor model		
	FLOW G1	
	FLOW G2	
	FLOW G3	
	FLOW G4	
	FLOW G5	
	FLOW P1	
	FLOW P2	
	FLOW P3	
	FLOW P4	
	FLOW P5	
	FLOW P6	
	FLOW P7	
	FLOW P8	
	FLOW P9	
	FLOW P10	
	PMECH1	
WEHGOV	PMECH2	
	PMECH3	
	PMECH4	
	PMECH5	
	PMECH6	
	PMECH7	
	PMECH8	

Category	Parameter Description	Data
Turbine Governor model		
	PMECH9	
	PMECH10	
HYGOVT	Prated, rated turbine power (MW)	
	Qrated, rated turbine flow (cfs or cms)	
	Hrated, rated turbine head (ft or m)	
	Grated, gate position at rated conditions (pu)	
	QNL, no power flow (pu of Qrated)	
	R, permanent droop	
	r, temporary droop (pu)	
	Tr, governor time constant (> 0) (sec)	
	Tf, filter time constant (> 0) (sec)	
	Tg, servo time constant (> 0) (sec)	
	MXGTOR, maximum gate opening rate (pu/sec)	
	MXGTCR, maximum gate closing rate (< 0) (pu/sec)	
	MXBGOR, maximum buffered gate opening rate (pu/sec)	
	MXBGCR, maximum buffered gate closing rate (< 0) (pu/sec)	
	BUFLIM, buffer upper limit (pu)	
	GMAX, maximum gate limit (pu)	
	GMIN, minimum gate limit (pu)	
	RVLVCR, relief valve closing rate (< 0) (pu/sec) or MXJDOR, maximum jet deflector opening rate (pu/sec)	
	RVLMAX, maximum relief valve limit (pu) or MXJDCR, maximum jet deflector closing rate (< 0) (pu/sec)	
	HLAKE, lake head (ft or m)	

Category	Parameter Description	Data
Turbine Governor model		
	HTAIL, tail head (ft or m)	
	PENLGTH, penstock length (ft or m)	
	PENLOS, penstock head loss coefficient (ft/cfs2 or m/cms2)	
	TUNLGTH, tunnel length (ft or m)	
	TUNLOS, tunnel head loss coefficient (ft/cfs2 or m/cms2)	
	SCHARE, surge chamber effective cross section (>0) (ft2 or m2)	
	SCHMAX, maximum water level in surge chamber (ft or m)	
	SCHMIN, minimum water level in surge chamber (ft or m)	
	SCHLOS, surge chamber orifice head loss coefficient (ft/cfs2 or m/cms2)	
	DAMP1, turbine damping under RPM1	
	RPM1, overspeed (pu)	
	DAMP2, turbine damping above RPM2	
	RPM2, overspeed (pu)	
	PENSPD, penstock wave velocity (>0) (ft/sec or m/sec)	
	PENARE, penstock cross section (>0) (ft2 or m2)	
	TUNSPD, tunnel wave velocity (>0) (ft/sec or m/sec)	
	TUNARE, tunnel cross section (>0) (ft2 or m2)	
	Rperm, permanent drop, pu	
	Treg (sec), speed detector time constant	
	Kp, proportional gain, pu/sec	
	Ki, reset gain, pu/sec	
	Kd, derivative gain, pu	

Category	Parameter Description	Data
Turbine Governor model		
PIDGOV	Ta (sec) > 0, controller time constant	
	Tb (sec) > 0, gate servo time constant	
	Dturb, turbine damping factor, pu	
	G0, gate opening at speed no load, pu	
	G1, intermediate gate opening, pu	
	P1, power at gate opening G1, pu	
	G2, intermediate gate opening, pu	
	P2, power at gate opening G2, pu	
	P3, power at full opened gate, pu	
	Gmax, maximum gate opening, pu	
	Gmin, minimum gate opening, pu	
	Atw > 0, factor multiplying Tw, pu	
	Tw (sec) > 0, water inertia time constant	
	Velmax, minimum gate opening velocity, pu/sec	
	Velmin < 0, minimum gate closing velocity, pu/sec	
HYGOVR1	db1, Intentional dead band width, Hz	
	Err, deadband hysteresis (p.u.)	
	Td (sec), Input filter time constant, s	
	T1 (sec), Lead time constant 1, s	
	T2 (sec) q, Lag time constant 1, s	
	T3 (sec), Lead time constant 2, s	
	T4 (sec), Lag time constant 2, s	
	T5 (sec), Lead time constant 3, s	

Category	Parameter Description	Data
Turbine Governor model		
	T6 (sec), Lag time constant 3, s	
	T7 (sec), Lead time constant 4, s	
	T8 (sec), Lag time constant 4, s	
	KP, proportional gain	
	R, Steady-state droop, p.u.	
	Tt, Power feedback time constant, s	
HYGOVR1	KG, Gate servo gain, p.u.	
	TP (sec), Gate servo time constant, s	
	VELOPEN, Maximum gate opening velocity, p.u./s	
	VELCLOSE, Maximum gate closing velocity, p.u./s (<0)	
	PMAX, Maximum gate opening, p.u. of mwcap	
	PMIN, Minimum gate opening, p.u. of mwcap	
	db2, Unintentional deadband, MW	
	TW (>0) water time constant	
	At, turbine gain	
	Dturb, turbine damping	
	qNL, no power flow	
	Trate (Turbine MW rating)	
	fDEAD (pu), Frequency Dead Band	
	fMIN (pu), Frequency Minimum Deviation	
	fMAX (pu), Frequency Maximum Deviation	
	KKOR (pu), Frequency Gain	
	KM > 0 (pu), Power Measurement Gain	

Category	Parameter Description	Data
Turbine Governor model		
TURCZT	KP (pu), Regulator Proportional Gain	
	SDEAD (pu), Speed Dead Band	
	KSTAT (pu), Speed Gain	
	KHP (pu), High Pressure Constant	
	TC (sec), Measuring transducer time constant	
	T 1 (sec), Regulator Integrator Time Constant	
	TEHP (sec), Hydro Converter Time Constant	
	TV > 0 (sec), Regulation Valve Time Constant	
	THP (sec), High Pressure Time Constant	
	TR (sec), Reheater time constant	
	TW (sec), Water Time Constant	
	NTMAX (pu), Power Regulator-Integrator Maximum Limiter	
	NTMIN (pu), Power Regulator-Integrator Minimum Limiter	
	GMAX (pu), Valve Maximum Open	
	GMIN (pu), Valve Minimum Open	
	VMIN (pu/sec), Valve Maximum Speed Close	
	VMAX (pu/sec), Valve Maximum Speed Open	
TWDM1T	R, permanent droop	
	r, temporary droop	
	Tr, governor time constant (>0)	
	Tf, filter time constant (>0)	
	Tg, servo time constant (>0)	
	VELMX, open gate velocity limit (pu/sec)	

Category	Parameter Description	Data
Turbine Governor model		
TWDM1	VELMN, close gate velocity limit (pu/sec) (<0)	
	GMAX, maximum gate limit	
	GMIN, minimum gate limit	
	TW, water time constant (sec) (>0)	
	At, turbine gain	
	Dturb, turbine damping	
	qNL, no power flow	
	F1, frequency deviation (pu)	
	TF1, time delay (sec)	
	F2, frequency deviation (pu)	
	sF2, frequency (pu/sec)	
	TF2, time delay (sec)	
	GMXRT, rate with which GMAX changes when TWD is tripped (pu/sec)	
	NREF, setpoint frequency deviation (pu)	
	Tft, frequency filter time constant (>0	
	TREG (sec), governor time constant (s)	
	Reg, permanent droop (p.u. on generator MVA rating)	
	KP, controller proportional gain (p.u.)	
	KI, controller integral gain (p.u./s)	
	KD, controller derivative gain (p.u.-s)	
	TA (sec) (> 0), controller time constant (s)	
	TB (sec) (> 0), controller time constant (s)	
	VELMX (pu/sec), open gate velocity limit (p.u./s)	

Category	Parameter Description	Data
Turbine Governor model		
TWDM2	VELMN (pu/sec) (> 0), close gate velocity limit (p.u./s)	
	GATMX (pu), maximum gate limit (p.u.)	
	GATMN (pu), minimum gate limit (p.u.)	
	TW (sec) (> 0), water time constant (s)	
	At, turbine gain	
	qNL, flow rate at no load (p.u.)	
	Dturb, turbine damping factor	
	F1, frequency deviation (pu)	
	TF1, time delay (sec)	
	F2, frequency deviation (pu)	
	sF2, frequency (pu/sec)	
	TF2, time delay (sec)	
	PREF, power reference (pu)	
	Tft, frequency filter time constant (sec) (>0)	
	TREG (sec), governor time constant (s)	
	REG1, permanent droop (p.u. on generator MVA base)	
	KP, controller proportional gain (p.u.)	
	KI, controller integral gain (p.u./s)	
	KD, controller derivative gain (p.u./s)	
	TA (>0) (sec), controller time constant (s)	
	TB (>0) (sec), controller time constant (s)	
	VELMX (>0), open gate velocity limit (p.u./s)	
	VELMN (<0), close gate velocity limit (p.u./s)	

Category	Parameter Description	Data
Turbine Governor model		
WPIDHY	GATMX, maximum gate limit (p.u.)	
	GATMN, minimum gate limit (p.u.)	
	TW (>0) (sec), water time constant (s)	
	PMAX, maximum gate position (p.u.)	
	PMIN, minimum gate position (p.u.)	
	D	
	G0, gate position at no load (p.u.)	
	G1, first gate intermediate position (p.u.)	
	P1, power at gate position G1 (p.u. on generator MVA rating)	
	G2, second gate intermediate position (p.u.)	
	P2, power at gate position G2 (p.u. on generator MVA rating)	
	P3, power at fully open gate (p.u. on generator MVA rating)	
WSHYDD	db1, deadband width (p.u.)	
	Err, deadband hysteresis (p.u.)	
	Td (sec), input filter time constant (s)	
	K1, derivative gain (p.u.)	
	Tf (sec), derivative time constant (s)	
	KD, double derivative gain (p.u.)	
	KP, integral gain (p.u.)	
	R, droop (p.u. on Trate)	
	Tt, power feedback time constant (s)	
	KG, gate servo gain (p.u.)	
	TP (sec), gate servo time constant (s)	

Category	Parameter Description	Data
Turbine Governor model		
WSHYDD	VELOPEN (>0), maximum gate opening rate (p.u./s)	
	VELCLOSE (>0), maximum gate closing rate (p.u./s)	
	PMAX, maximum gate opening (p.u.)	
	PMIN, minimum gate opening (p.u.)	
	db2, deadband (p.u.)	
	GV1, coordinate of power-gate look-up table (p.u. gate)	
	PGV1, coordinate of power-gate look-up table (p.u. power)	
	GV2, coordinate of power-gate look-up table (p.u. gate)	
	PGV2, coordinate of power-gate look-up table (p.u. power)	
	GV3, coordinate of power-gate look-up table (p.u. gate)	
	PGV3, coordinate of power-gate look-up table (p.u. power)	
	GV4, coordinate of power-gate look-up table (p.u. gate)	
	PGV4, coordinate of power-gate look-up table (p.u. power)	
	GV5, coordinate of power-gate look-up table (p.u. gate)	
	PGV5, coordinate of power-gate look-up table (p.u. power)	
	Aturb, turbine lead time constant multiplier	
	Bturb (> 0), turbine lag time constant multiplier	
	Tturb (> 0) (sec), turbine time constant (s)	
	Trate, turbine rating (MW)	
	db1, deadband width (p.u.)	
	Err, deadband hysteresis (p.u.)	
	Td (sec), input filter time constant (s)	
	K1, derivative gain (p.u.)	

Category	Parameter Description	Data
Turbine Governor model		
WSHYGP	Tf (sec), derivative time constant (s)	
	KD, double derivative gain (p.u.)	
	KP, integral gain (p.u.)	
	R, droop (p.u. on Trate)	
	Tt, power feedback time constant (s)	
	KG, gate servo gain (p.u.)	
	TP (sec), gate servo time constant (s)	
	VELOPEN (>0), maximum gate opening rate (p.u./s)	
	VELCLOSE (>0), maximum gate closing rate (p.u./s)	
	PMAX, maximum gate opening (p.u.)	
	PMIN, minimum gate opening (p.u.)	
	db2, deadband (p.u.)	
	GV1, coordinate of power-gate look-up table (p.u. gate)	
	PGV1, coordinate of power-gate look-up table (p.u. power)	
	GV2, coordinate of power-gate look-up table (p.u. gate)	
	PGV2, coordinate of power-gate look-up table (p.u. power)	
	GV3, coordinate of power-gate look-up table (p.u. gate)	
	PGV3, coordinate of power-gate look-up table (p.u. power)	
	GV4, coordinate of power-gate look-up table (p.u. gate)	
	PGV4, coordinate of power-gate look-up table (p.u. power)	
WSHYGP	GV5, coordinate of power-gate look-up table (p.u. gate)	
	PGV5, coordinate of power-gate look-up table (p.u. power)	
	Aturb, turbine lead time constant multiplier	

Category	Parameter Description	Data
Turbine Governor model		
	Bturb (> 0), turbine lag time constant multiplier	
	Tturb (> 0) (sec), turbine time constant (s)	
	Trate, turbine rating (MW)	
GAST	R, permanent droop	
	T1 (>0) (sec), Governor mechanism time constant	
	T2 (>0) (sec), Turbine power time constant	
	T3 (>0) (sec), Turbine exhaust temperature time constant	
	Ambient temperature load limit, AT	
	KT, Temperature limiter gain	
	VMAX, Maximum turbine power	
	VMIN, Minimum turbine power	
	Dturb, Turbine damping factor	
	W, governor gain (1/droop) (on turbine rating)	
	X (sec) governor lead time constant	
	Y (sec) (> 0) governor lag time constant	
	Z, governor mode:1 Droop or 0 ISO	
	ETD (sec), Turbine exhausts time constant	
	TCD (sec), Gas turbine dynamic time constant	
	TRATE turbine rating (MW)	
	T (sec), Fuel control time constant	
	MAX (pu) limit (on turbine rating)	
	MIN (pu) limit (on turbine rating)	
	ECR (sec), Combustor time constant	

Category	Parameter Description	Data
Turbine Governor model		
GAST2A	K3, Fuel control gain	
	a (> 0) valve positioner	
	b (sec) (> 0) valve positioner	
	c valve positioner	
	Tf (sec) (> 0), Fuel system time constant	
	Kf, feedback gain	
	K5, Radiation shield	
	K4, Radiation shield	
	T3 (sec) (> 0), Radiation shield time constant	
	T4 (sec) (> 0), Thermocouple time constant, seconds	
	Tt (> 0), Temperature control time constant	
	T5 (sec) (> 0), Temperature control time constant	
	af1, describes the turbine characteristic	
	bf1, describes the turbine characteristic	
	af2, describes the turbine characteristic	
	bf2, describes the turbine characteristic	
	cf2, describes the turbine characteristic	
	TR (degree), Rated temperature	
	K6 (pu), Minimum fuel flow	
	TC (degree), Temperature control	
	KDROOP (on turbine rating)	
	KP, Proportional gain	
	KI, Integral gain	

Category	Parameter Description	Data
Turbine Governor model		
GASTWD	KD, Derivative gain	
	ETD (sec), Turbine exhaust time constant	
	TCD (sec), Gas turbine dynamic time constant	
	TRATE turbine rating (MW)	
	T (sec), Fuel control time constant	
	MAX (pu) limit (on turbine rating)	
	MIN (pu) limit (on turbine rating)	
	ECR (sec), Combustor time constant	
	K3, Fuel control gain	
	a (> 0) valve positioner	
	b (sec) (> 0) valve positioner	
	c valve positioner	
	tf (sec) (> 0), Fuel system time constant	
	Kf, feedback gain	
	K5, Radiation shield	
	K4, Radiation shield	
	T3 (sec) (> 0), Radiation shield time constant	
	T4 (sec) (> 0), Thermocouple time constant, seconds	
	tt (> 0), Temperature control time constant	
	T5 (sec) (> 0), Temperature control time constant	
	af1, describes the turbine characteristic	
	bf1, describes the turbine characteristic	
	af2, describes the turbine characteristic	

Category	Parameter Description	Data
Turbine Governor model		
	bf2 (>0), describes the turbine characteristic	
	cf2, describes the turbine characteristic	
	TR(degree), Rated temperature1	
	K6 (pu), Minimum fuel flow	
	TC (degree), Temperature control1	
	TD (sec) (> 0), Power transducer	
WESGOV	ΔTC (sec), Δt sample for controls	
	ΔTP (sec), Δt sample for PE	
	Power Droop	
	Kp, Trubine proportional gain	
	TI (> 0) (sec), Integral time constant	
	T1 (sec), Constant time	
	T2 (sec), Constant time	
	ALIM	
	Tpe (sec), Power time constant	
	R, Permanent droop, pu	
	Tpelec, Electrical power transducer time constant, sec	
	maxerr, Maximum value for speed error signal	
	minerr, Minimum value for speed error signal	
	Kpgov, Governor proportional gain	
	Kigov, Governor integral gain	
	Kdgov, Governor derivative gain	
	Tdgov, Governor derivative controller time constant, sec	

Category	Parameter Description	Data
Turbine Governor model		
GGOV1	vmax, Maximum valve position limit	
	vmin, Minimum valve position limit	
	Tact, Actuator time constant, sec	
	Kturb, Turbine gain	
	Wfnl, No load fuel flow, pu	
	Tb, Turbine lag time constant, sec	
	Tc, Turbine lead time constant, sec	
	Teng, Transport lag time constant for diesel engine, sec	
	Tfload, Load Limiter time constant, sec	
	Kpload, Load limiter proportional gain for PI controller	
	Kiload, Load limiter integral gain for PI controller	
	Ldref, Load limiter reference value pu	
	Dm, Mechanical damping coefficient, pu	
	Ropen, Maximum valve opening rate, pu/sec	
	Rclose, Maximum valve closing rate, pu/sec	
	Kimw, Power controller (reset) gain	
	Aset, Acceleration limiter setpoint, pu/sec	
	Ka, Acceleration limiter gain	
	Ta, Acceleration limiter time constant, sec (> 0)	
	Trate, Turbine rating (MW)1	
	db, Speed governor deadband	
	Tsa, Temperature detection lead time constant, sec	
	Tsb, Temperature detection lag time constant, sec	

Category	Parameter Description	Data
Turbine Governor model		
	Rup, Maximum rate of load limit increase	
	Rdown, Maximum rate of load limit decrease	
PWTBD1	Trate (MW), Turbine rating (MW)	
	K (pu), Proportional gain	
	Ki (pu), Integral gain	
	Vrmax (pu), Upper Limit of PI controller	
	Vrmin (pu), Lower Limit of PI controller	
	Tv (s) (>0), Control valve Time Constant	
	Lo (pu/sec) (>0), Control valve open rate limit	
	Lc (pu/sec) (>0), Control valve close rate limit	
	Vmax (pu), Maximum valve position	
	Vmin (pu), Minimum valve position	
	Tb1 (s), steam buffer time constant	
	Tb2 (s), steam buffer time constant	
	v1 (pu), valve position 1	
	p1 (pu), power output for valve position v1	
	v2 (pu), valve position 2	
	p2 (pu), power output for valve position v2	
	v3 (pu), valve position 3	
	p3 (pu), power output for valve position v3	
	v4 (pu), valve position 4	
	p4 (pu), power output for valve position v4	
	v5 (pu), valve position 5	

Category	Parameter Description	Data
Turbine Governor model		
PWTBD1	p5 (pu), power output for valve position v5	
	v6 (pu), valve position 6	
	p6 (pu), power output for valve position v6	
	v7 (pu), valve position 7	
	p7 (pu), power output for valve position v7	
	v8 (pu), valve position 8	
	p8 (pu), power output for valve position v8	
	v9 (pu), valve position 9	
	p9 (pu), power output for valve position v9	
	v10 (pu), valve position 10	
	p11 (pu), power output for valve position v11	
	v11 (pu), valve position 11	
	p11 (pu), power output for valve position v11	
	W, governor gain (1/droop) (on turbine rating)	
	X (sec) governor lead time constant	
	Y (sec) (> 0) governor lag time constant	
	Z, governor mode:1 Droop or 0 ISO	
	ETD (sec), Turbine exhausts time constant	
	TCD (sec), Gas turbine dynamic time constant	
	TRATE turbine rating (MW)	
	T (sec), Fuel control time constant	
	MAX (pu) limit (on turbine rating)	
	MIN (pu) limit (on turbine rating)	

Category	Parameter Description	Data
Turbine Governor model		
URCSCT	ECR (sec), Combustor time constant	
	K3, Fuel control gain	
	a (> 0) valve positioner	
	b (sec) (> 0) valve positioner	
	c valve positioner	
	Tf (sec) (> 0), Fuel system time constant	
	Kf, feedback gain	
	K5, Radiation shield	
	K4, Radiation shield	
	T3 (sec) (> 0), Radiation shield time constant	
	T4 (sec) (> 0), Thermocouple time constant, seconds	
	Tt (> 0), Temperature control time constant	
	T5 (sec) (> 0), Temperature control time constant	
	af1, describes the turbine characteristic	
	bf1, describes the turbine characteristic	
	af2, describes the turbine characteristic	
	bf2, describes the turbine characteristic	
	cf2, describes the turbine characteristic	
	TR (degree), Rated temperature	
	K6 (pu), Minimum fuel flow	
	TC (degree), Temperature control	
	K, Governor gain, (1/droop) pu	
	T1 (sec), Lag time constant (sec)	

Category	Parameter Description	Data
Turbine Governor model		
	T2 (sec), Lead time constant (sec)	
	T3 (> 0) (sec), valve position time constant	
	Uo (pu/sec), maximum valve opening rate	
	Uc (< 0) (pu/sec), maximum valve closing rate	
	PMAX (pu on machine MVA rating)	
	PMIN (pu on machine MVA rating)	
URSCT	T4 (sec), time constant for steam inlet	
	K1, HP fraction	
	K2, LP fraction	
	T5 (sec), Time Constant for Second Boiler Pass [s]	
	K3, HP Fraction	
	K4, LP fraction	
	T6 (sec), Time Constant for Third Boiler Pass [s]	
	K5, HP Fraction	
	K6, LP fraction	
	T7 (sec), Time Constant for Fourth Boiler Pass [s]	
	K7, HP Fraction	
	K8, LP fraction	
	ST Rating, Steam turbine rating (MW)	
	POUT A, Plant total, point A (MW)	
	STOUT A, Steam turbine output, point A (MW)	
	POUT B, Plant total, point B (MW)	
	STOUT B, Steam turbine output, point B (MW)	

Category	Parameter Description	Data
Turbine Governor model		
	POUT C, Plant total, point C (MW)	
	STOUT C, Steam turbine output, point C (MW)	
URGS3T	R	
	T1 (> 0) (sec)	
	T2 (> 0) (sec)	
	T3 (> 0) (sec)	
	Lmax	
	Kt	
	Vmax	
	Vmin	
	Dturb	
	Fidle	
	Rmax	
	Linc (> 0)	
	Tltr (>0) (sec)	
	Ltrat	
	a	
	b (> 0)	
	db1, dead band width (p.u.)	
	Err, deadband hysteresis (p.u.)	
	db2, dead band width (p.u.)	
	GV1, coordinate of power-gate look-up table (p.u. gate)	
	PGV1, coordinate of power-gate look-up table (p.u. power)	

Category	Parameter Description	Data
Turbine Governor model		
	GV2, coordinate of power-gate look-up table (p.u. gate)	
	PGV2, coordinate of power-gate look-up table (p.u. power)	
	GV3, coordinate of power-gate look-up table (p.u. gate)	
	PGV3, coordinate of power-gate look-up table (p.u. power)	
	GV4, coordinate of power-gate look-up table (p.u. gate)	
	PGV4, coordinate of power-gate look-up table (p.u. power)	
	GV5, coordinate of power-gate look-up table (p.u. gate)	
	PGV5, coordinate of power-gate look-up table (p.u. power)	
	Ka	
	T4	
	T5	
	MWCAP	

Annexure-5

List of Test/Study Reports required to be furnished by applicant in compliance of CEA (Technical Standards for Connectivity to the Grid) Regulations, 2007 as amended

In compliance of Connectivity Standards, the applicant shall submit the following Test/Study Reports as part of CONN-4 documents as per the sequence indicated below:

1) Details of excitation system of generating unit

2) Short circuit ratio of generating unit

3) Reactive power capability

Clause No. of Connectivity Regulation	Detailed clause	Reports/data in compliance of CEA Technical Standards for Connectivity to the Grid for Conventional Generators
A1(1)	New Generating units The excitation system for every generating unit: a) shall have state of the art excitation system b) Shall have Automatic Voltage Regulator (AVR). Generators of 100 MW rating and above shall have Automatic Voltage Regulator with digital control and two separate channels having	1. Applicant shall submit the details of excitation system alongwith parameters of the proposed generating unit For the generator capacity exceeding 100MW, applicant shall submit the details of PSS and AVR alongwith parameters to be used.

Clause No. of Connectivity Regulation	Detailed clause	Reports/data in compliance of CEA Technical Standards for Connectivity to the Grid for Conventional Generators
	independent inputs and automatic changeover; The Automatic Voltage Regulator of generator of 100 MW and above shall include Power System Stabilizer (PSS)	
A1 (2)	The short circuit ratio for generator shall be as per IEC-34	Applicant shall be required to furnish the OEM document depicting SCR of generating unit.
A1 (3)	The generator transformer winding shall have delta construction on low voltage side and star connection on high voltage side. Star point of high voltage side shall be effectively(solidly) earthen so as to achieve earth fault factor of 1.4 or less	1. Applicant shall submit the SLD of station depicting connection configuration of Generator transformer and generating unit Applicant shall submit the earth fault factor at sub-station
A1 (4)	All generating machines irrespective of capacity shall have electronically controlled governing system with appropriate speed/load characteristics to regulate frequency. The governors of thermal generating units shall	Applicant shall submit the GTP/manual indicating droop characteristics of generating unit

<table>
<tr><th>Clause No. of Connectivity Regulation</th><th>Detailed clause</th><th>Reports/data in compliance of CEA Technical Standards for Connectivity to the Grid for Conventional Generators</th></tr>
<tr><td></td><td>have a droop of 3 to 6% and those of hydro generating units 0 to 10%.</td><td></td></tr>
<tr><td>A1 (5)</td><td>Generating Units located near load centre, shall be capable of operating at rated output for power factor varying between 0.85 lagging (over-excited) to 0.95 leading (under-excited) and Generating Units located far from load centres shall be capable of operating at rated output for power factor varying between 0.9 lagging (over-excited) to 0.95 leading (Under-excited).

The above performance shall also be achieved with voltage variation of ± 5% of nominal, frequency variation of + 3% and -5% and combined voltage and frequency variation of ±5%. However, for gas turbines, the above performance shall be achieved for voltage variation of ±5%.</td><td>Applicant shall submit report indicating performance of power plant with the help of unit PQ capability curves considering different voltage levels (1.05,1.0,0.95 pu) under different power factors (0.85 lag- unity-0.95 lead). List of studies to be provided are tabulated below:

a) With fixed frequency (50Hz)

<table>
<tr><th>Voltage</th><th>1.0 PF</th><th>0.95 lagging</th><th>0.95 leading</th></tr>
<tr><td>1.0 pu</td><td>To be provided</td><td>To be provided</td><td>To be provided</td></tr>
<tr><td>0.95 pu</td><td>To be provided</td><td>To be provided</td><td>-</td></tr>
<tr><td>1.05 pu</td><td>To be provided</td><td>-</td><td>To be provided</td></tr>
</table>
b) With fixed voltage (1pu)

<table>
<tr><th>Frequency</th><th>1.0 PF</th><th>0.95 lagging</th><th>0.95 leading</th></tr>
<tr><td>+ 3%</td><td>To be provided</td><td>To be provided</td><td>To be provided</td></tr>
<tr><td>-5%</td><td>To</td><td>To be</td><td>To be</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Clause No. of Connectivity Regulation</th><th>Detailed clause</th><th>Reports/data in compliance of CEA Technical Standards for Connectivity to the Grid for Conventional Generators</th></tr>
<tr><td></td><td>Provided also that all hydro-electric generating units, where Techno-Economic concurrence has been accorded by the Authority (CEA) under section 8 of the Act, shall be capable of operating at the rated output at the power factor as specified in such techno-economic concurrence</td><td>
<table>
<tr><td></td><td>be provided</td><td>provided</td><td>provided</td></tr>
</table>
c) With variable voltage and frequency
<table>
<tr><th></th><th>1.0 PF</th><th>0.85 lagging</th><th>0.95 leading</th></tr>
<tr><td>V:1.05pu, Δf:+5%</td><td>To be provided</td><td>To be provided</td><td>To be provided</td></tr>
<tr><td>V:1.05pu, Δf:-5%</td><td>To be provided</td><td>To be provided</td><td>To be provided</td></tr>
<tr><td>V: 0.95pu, Δf:+5%</td><td>To be provided</td><td>To be provided</td><td>To be provided</td></tr>
<tr><td>V: 0.95pu, Δf:-5%</td><td>To be provided</td><td>To be provided</td><td>To be provided</td></tr>
</table>
</td></tr>
<tr><td>A1 (6)</td><td>The coal and lignite based thermal generating units shall be capable of generating up to 105% of Maximum Continuous Rating (MCR) (subject to maximum load capability under Valve Wide Open Condition) for short duration to provide the frequency response.</td><td>Applicant shall submit the generator unit capability depicting MCR under valve wide open (VWO) condition</td></tr>
</table>

Clause No. of Connectivity Regulation	Detailed clause	Reports/data in compliance of CEA Technical Standards for Connectivity to the Grid for Conventional Generators
A1 (7)	The hydro generating units shall be capable of generating up to 110% of rated capacity (subject to rated head being available) on continuous basis	Applicant (Hydro) shall submit the generator unit capability depicting 110% generating capacity on continuous basis.
A1 (8)	Every generating unit shall have standard protections to protect the units not only from faults within the units and within the station but also from faults in transmission lines. For generating unit having rated capacity greater than 100 MW, two independent sets of protections acting on two independent sets of trip coils fed from independent Direct Current (DC) supplies shall be provided. The protections shall include but not be limited to the Local Breaker Back-up (LBB) protection	Applicant shall submit the protection schemes to be implemented for compliance of CEA Technical Standards
A1 (9)	Hydro generating units having rated capacity of 50 MW and above shall be capable of operation in synchronous condenser mode, wherever	Applicant (for unit capacity more than 50MW) shall submit generating unit OEM GTP indicating capability of operation hydro unit under synchronous condenser mode. In

Clause No. of Connectivity Regulation	Detailed clause	Reports/data in compliance of CEA Technical Standards for Connectivity to the Grid for Conventional Generators
	feasible. Provided that hydro generating units commissioned on or after 01.01.2014 and having rated capacity of 50 MW and above shall be equipped with facility to operate in synchronous condenser mode, if necessity for the same is established by the: interconnection studies	case of non-availability of the facility of synchronous condenser mode of operation, the detailed reasoning for the same should be furnished.
A1 (10)	Bus bar protection shall be provided at the switchyard of all generating station.	Applicant shall submit the bus bar scheme implemented in sub-station
A1 (11)	Automatic synchronization facilities shall be provided in the requester's Project.	Applicant shall submit the details of relay provided with synchronization facility at generating station
A1 (12)	The station auxiliary power requirement, including voltage and reactive requirements, shall not impose operating restrictions on the grid beyond those specified in the Grid Code or state Grid Code as the case may be.	Applicant shall submit declaration that station auxiliary power requirement, including voltage and reactive requirements, shall not impose operating restrictions on the grid beyond those specified in the Grid Code or State Grid Code as the case may be.
A1 (13)	In case of hydro generating units, self-starting facility may	Applicant shall submit the details of self-starting facilities implemented in

Clause No. of Connectivity Regulation	Detailed clause	Reports/data in compliance of CEA Technical Standards for Connectivity to the Grid for Conventional Generators
	be provided. The hydro generating station may also have a small diesel generator for meeting the station auxiliary requirements for black start.	respect of generating unit for hydro generating stations.
DA1 (14)	The standards in respect of the sub-stations associated with the generating stations shall be in accordance with the provisions specified in respect of 'Sub-station' under Part III of these Standards.	Applicant shall submit the details of sub-station equipment as a part of CON-4 data.

In order to check the performance of generating unit, applicant shall submit the plant model (Generic) compatible to PSS/E latest version with following information:

- SLD (Unit & Switchyard Sub-station)
- Generating OEM Technical datasheet
- Excitation system Technical datasheet
- Power System Stabilizer Technical datasheet
- Turbine governor system Technical datasheet

➢ PSS/E model shall demonstrate the steady state as well as dynamic state performance of the complete plant.

➢ Model should be suitable for an integration time step between 1ms and 20ms, and suitable for operation up-to 100s

List of simulation tests to be carried out in PSS/E software:

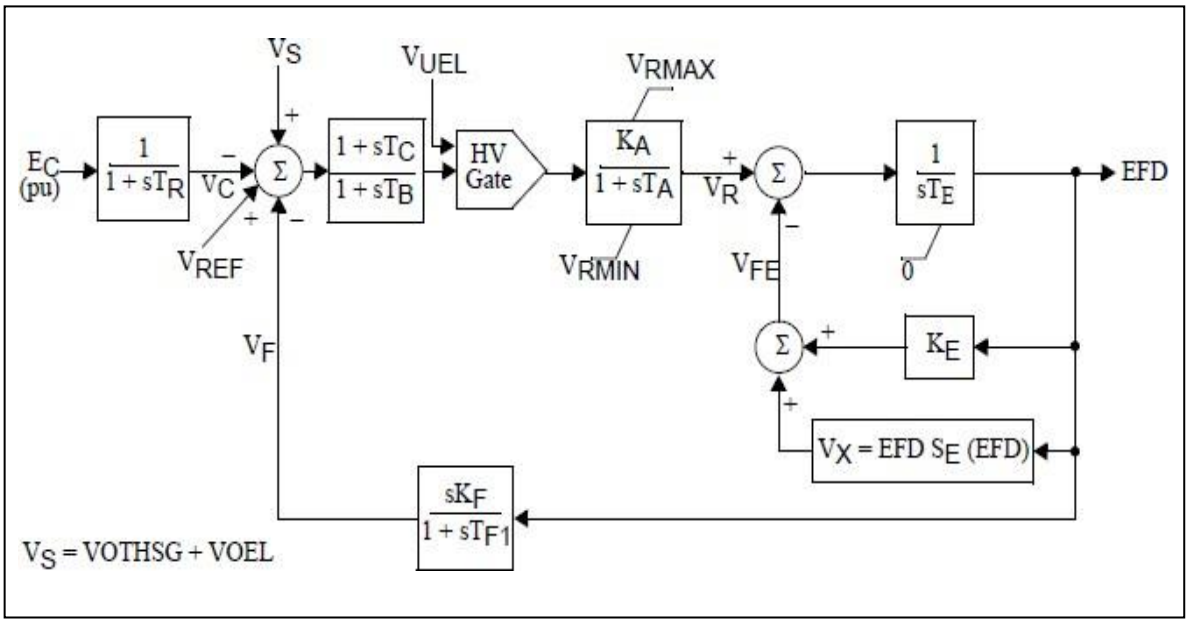
Sl. No.	Name of test	Remarks
1	Voltage Step (up/down) response of exciters of generator unit	Applicant shall submit the step response of exciter for following conditions: a) Change of POI voltage from 1.0 to 0.95pu b) Change of POI voltage from 1.0 to 1.05pu Report shall include relevant plots of electrical quantities including voltage, current, active power, reactive power, electrical angle of candidate Generator and balance units.
2	Generator response during Single line to ground fault (100ms) at its terminal (considering nil fault impedance)	Applicant shall submit the generator response during SLG fault at Generator terminal. Report shall include relevant plots of electrical quantities including voltage, current, active power, reactive power, angle of candidate Generator and balance units.
3	Generator response during Three phase fault (100ms) at its terminal (considering nil fault impedance)	Applicant shall submit the generator response during three phase fault at bus bar (including GT). Report shall include relevant plots of electrical quantities including voltage, current, active power, reactive power, electrical angle of candidate Generator and balance units.

Sl. No.	Name of test	Remarks
4	Generator droop test	Applicant shall demonstrate the droop characteristics of a Generating Unit
5	Reactive power capability of generator unit for voltage limits of ± 5%, frequency variations of + 3% and -5% and its combined effect	Applicant shall submit the reactive power absorption/injection capability of Generating unit as individual and aggregated response at HV bus bar through simulation. Applicant shall attach the plots of electrical quantities including terminal voltage, field voltage, stator current, field current, active power & reactive power, EFD.

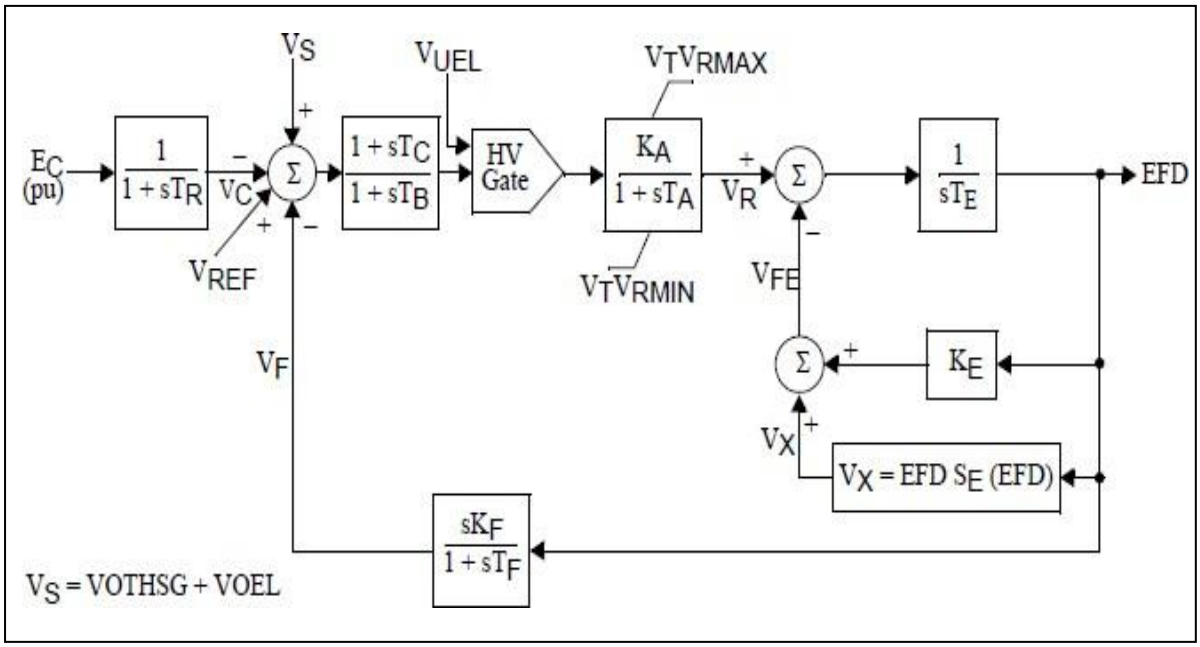
Annexure-6

1. DC Exciters Generic model:

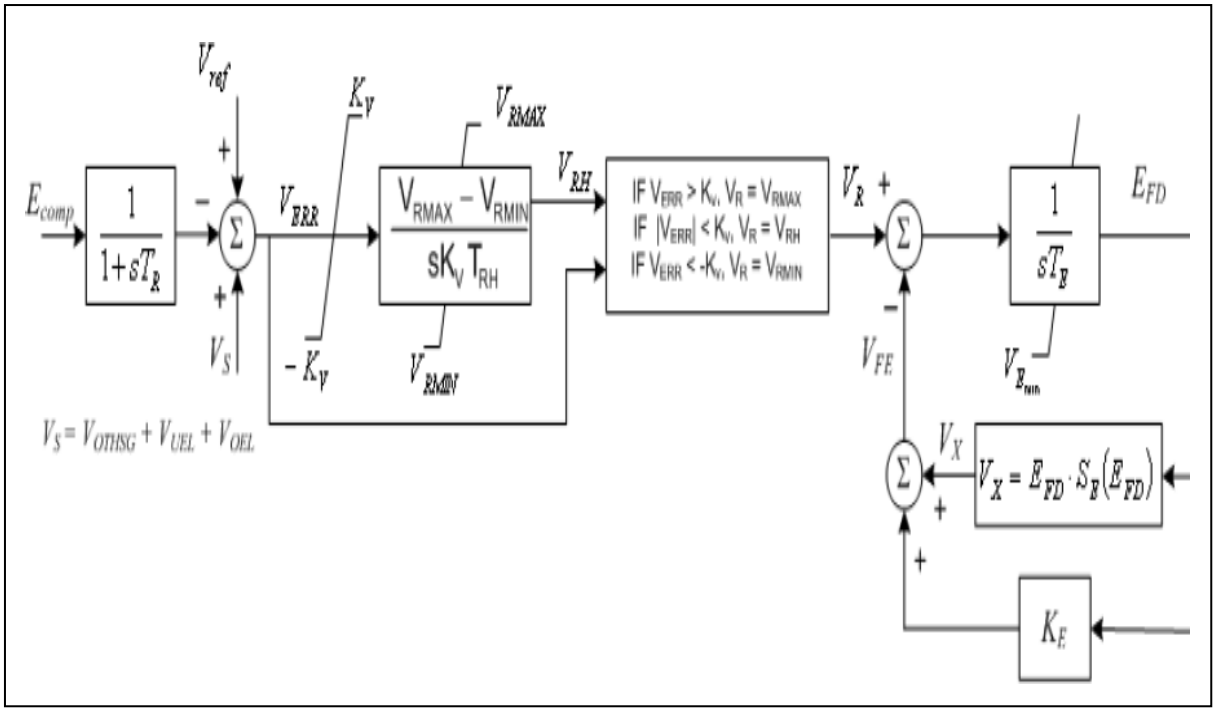
➢ Type DC1A: 1992 IEEE type DC1A excitation system model



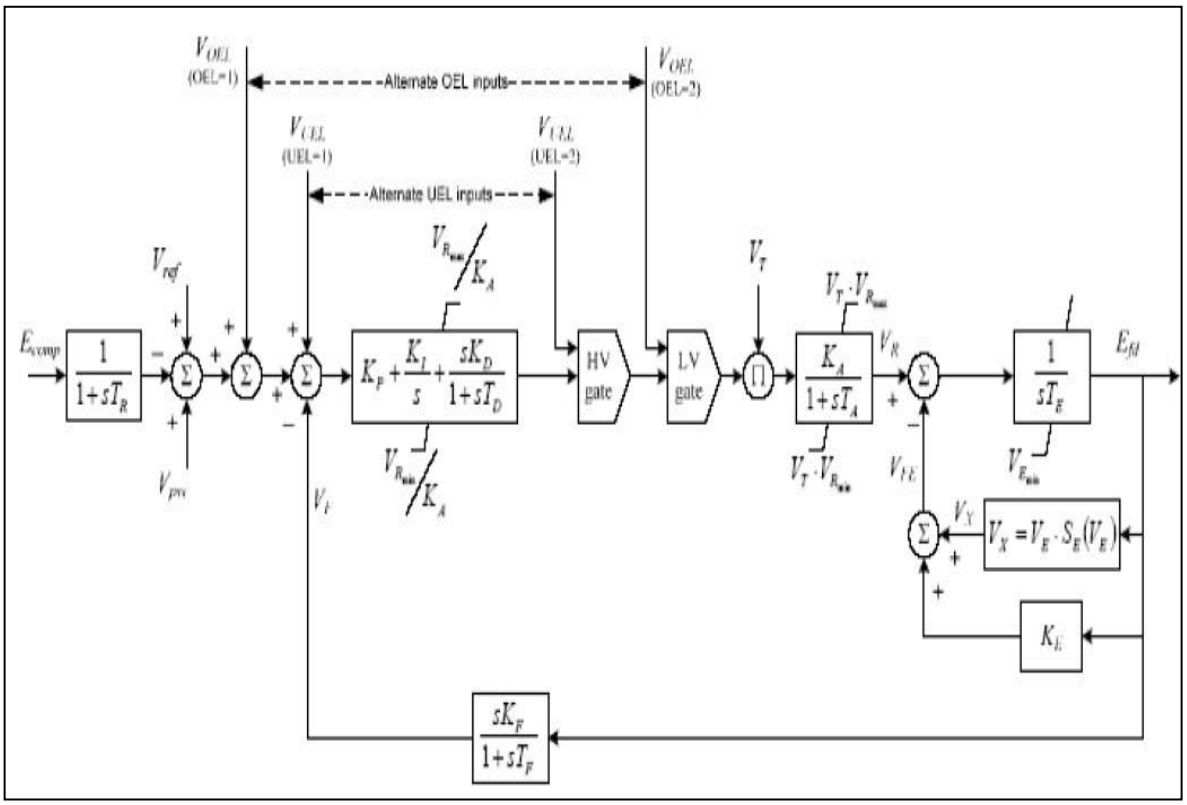
➢ Type DC2A: 1992 IEEE type DC2A excitation system model



- **Type DC3A: IEEE 421.5 2005 DC3A excitation system**

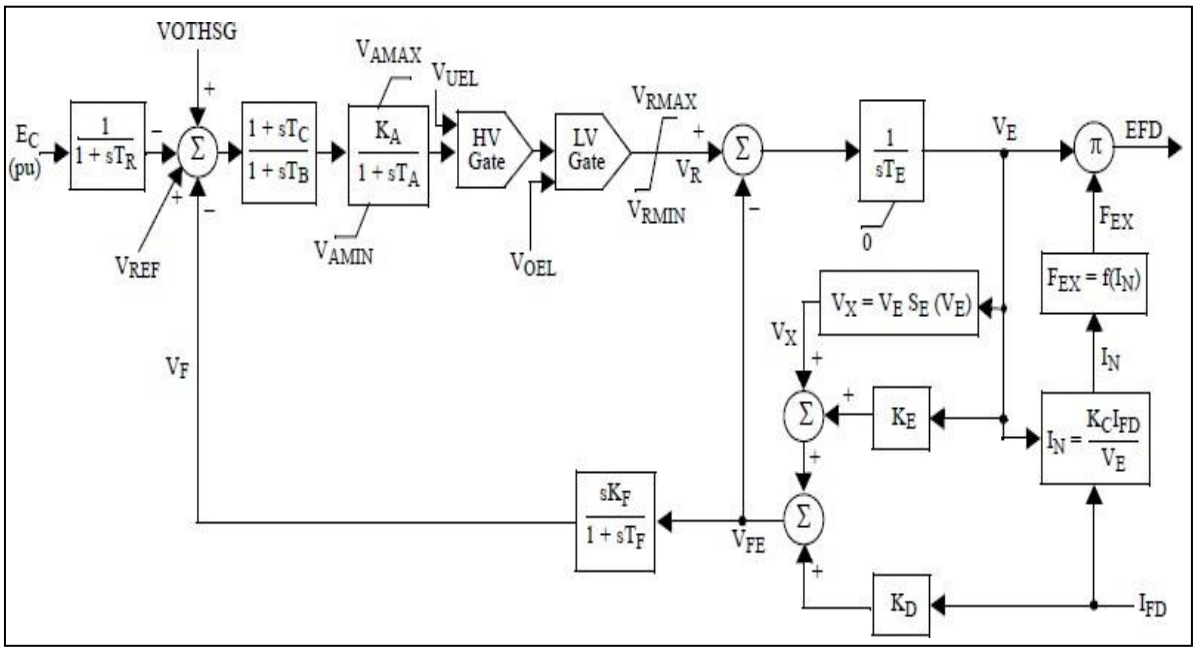


- **Type DC4B: IEEE 421.5 2005 DC4B excitation system**

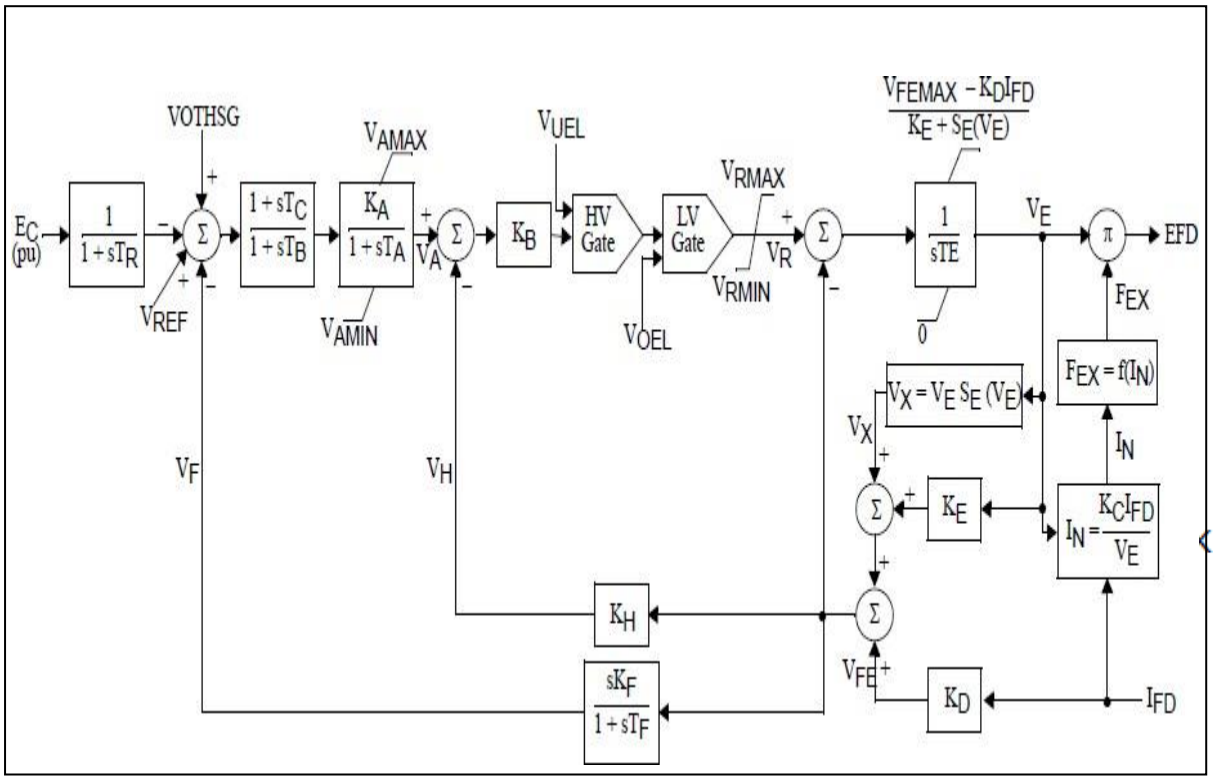


2. AC Exciters Generic Models:

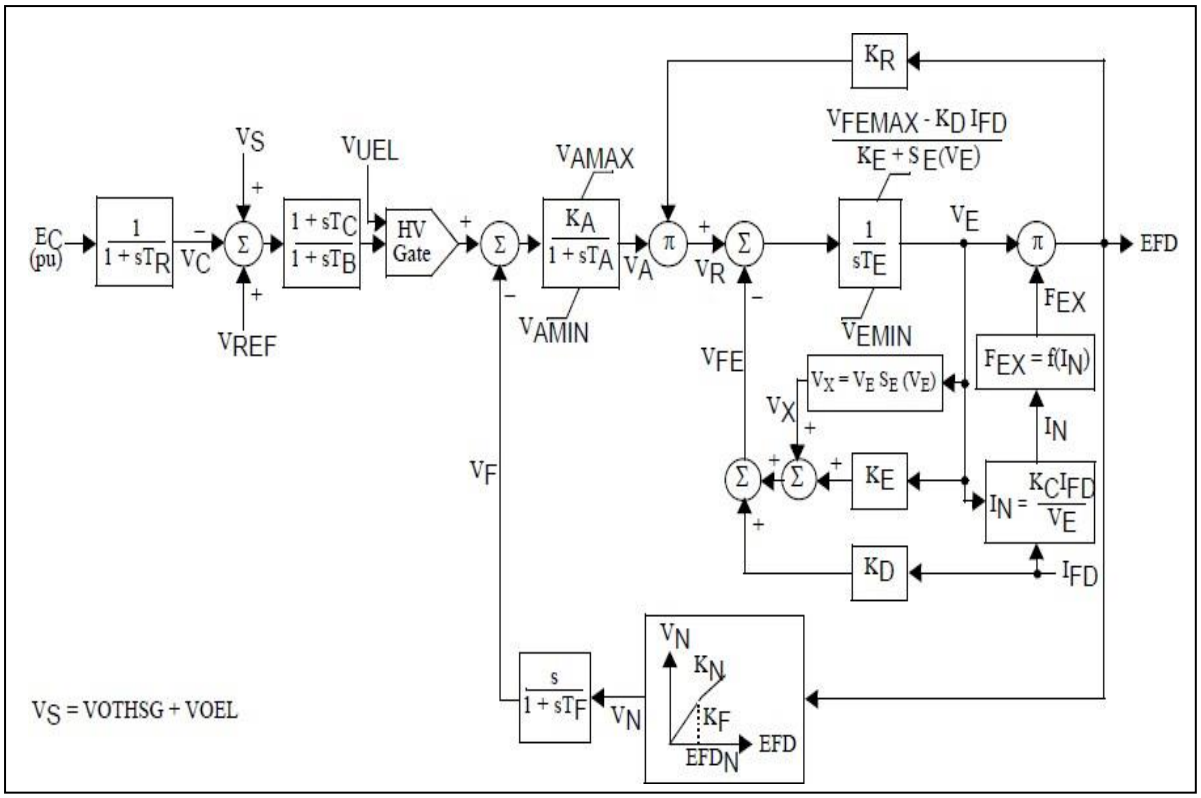
➢ Type AC1A: 1992 IEEE type AC1A excitation system model



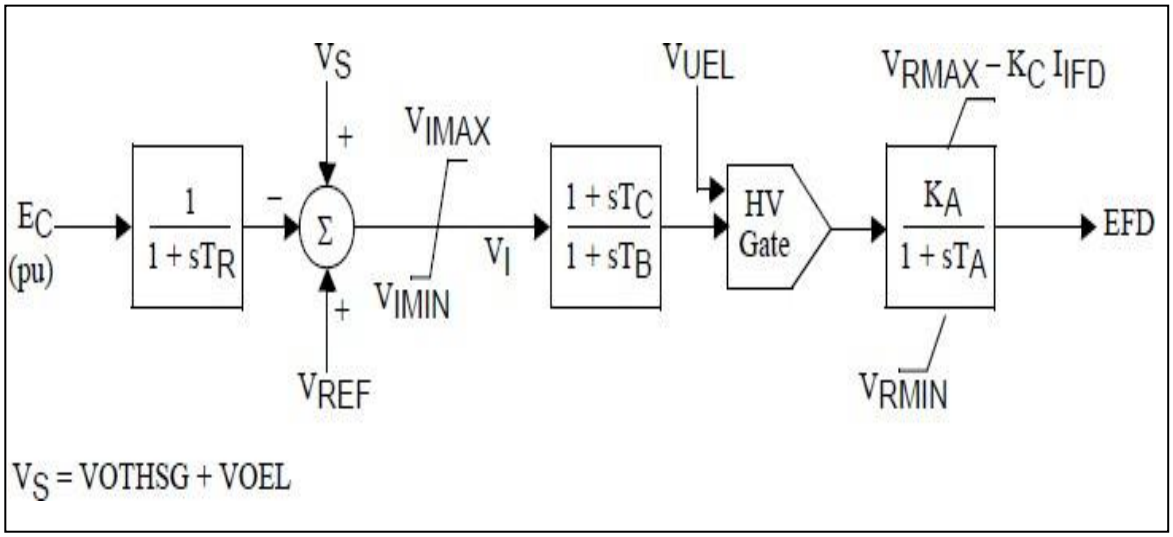
➢ Type AC2A: 1992 IEEE type AC2A excitation system model



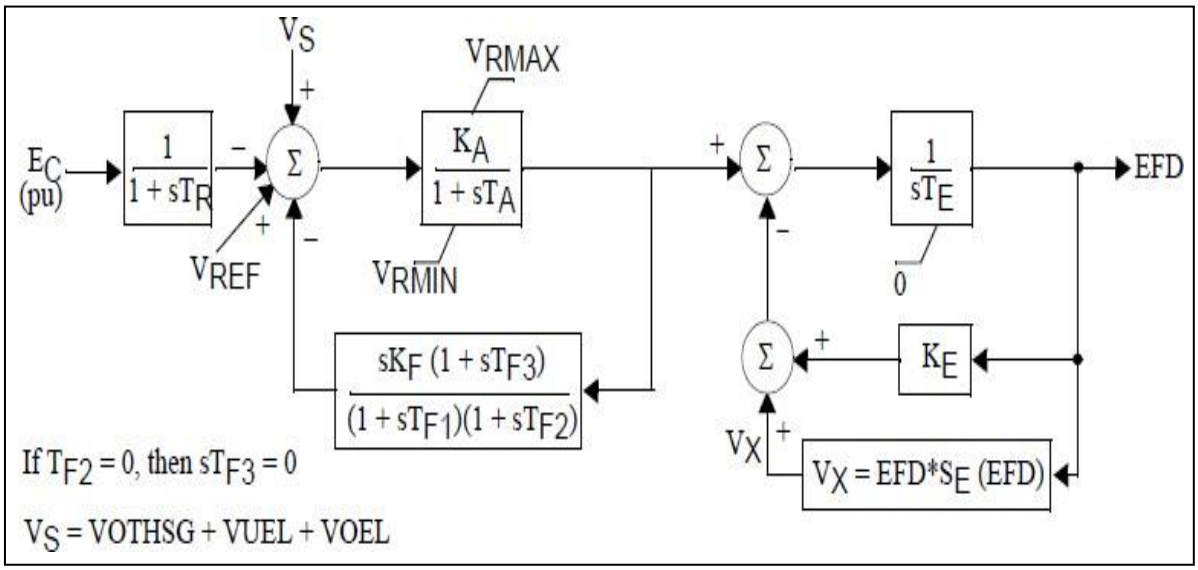
➢ Type AC3A: 1992 IEEE type AC3A excitation system model



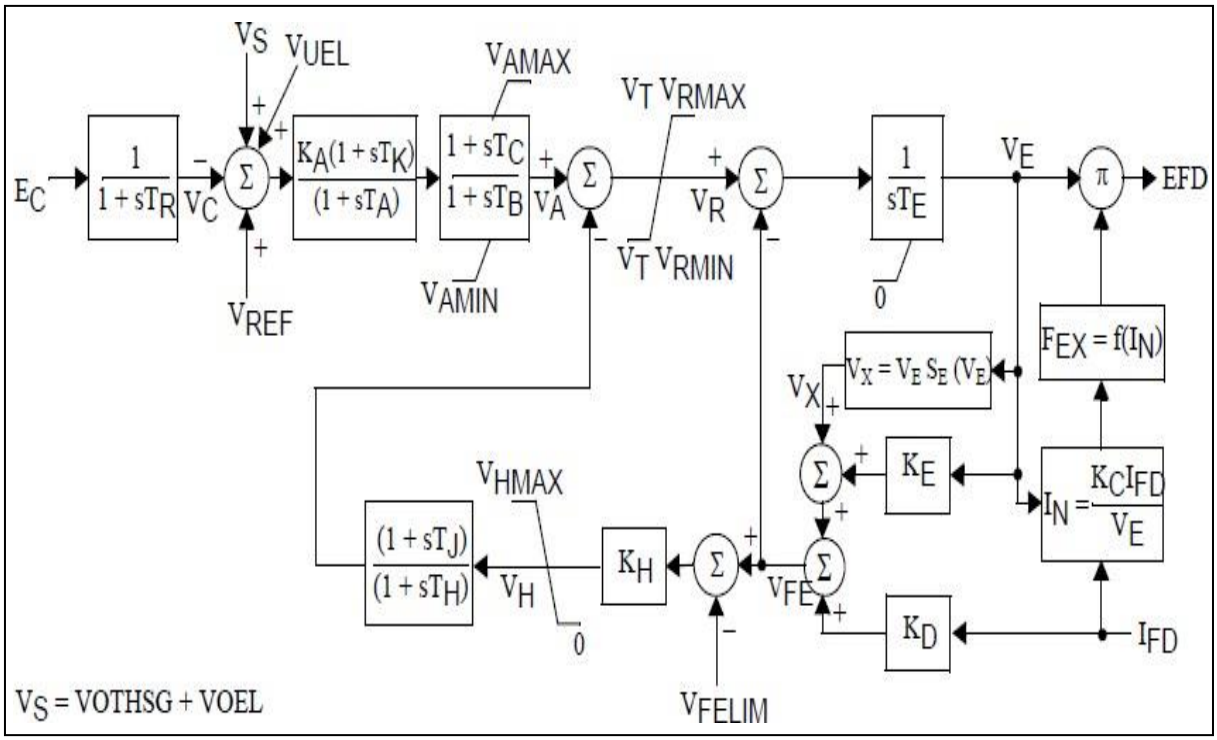
- **Type AC4A: 1992 IEEE type AC4A excitation system model**



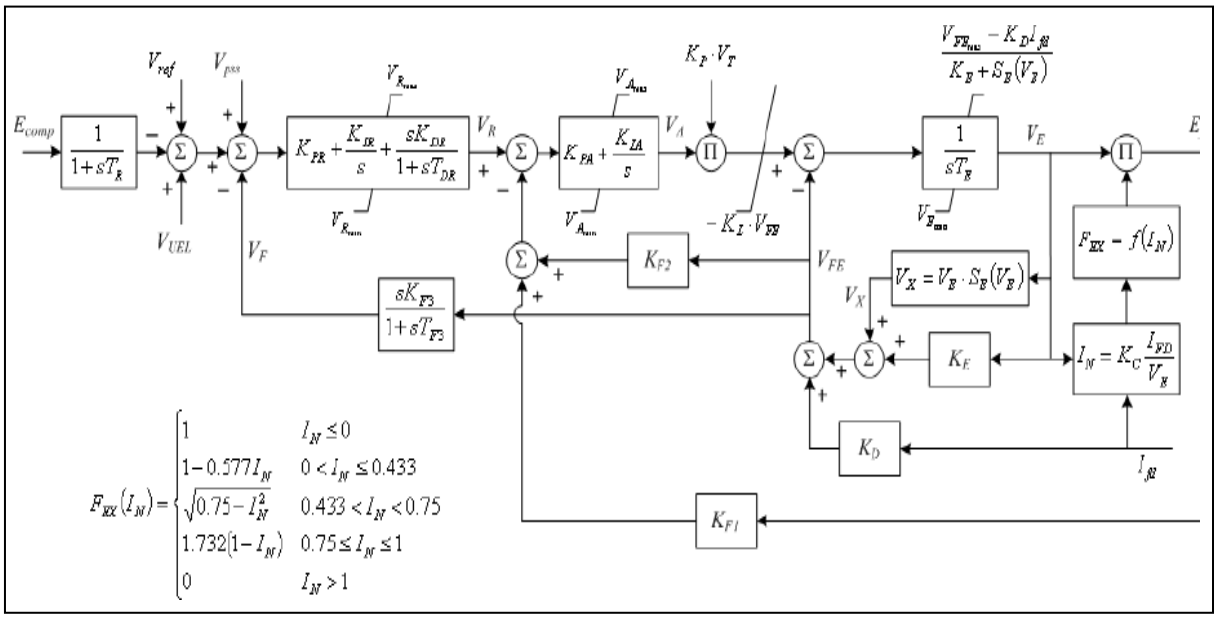
- **Type AC5A: 1992 IEEE type AC5A excitation system model**



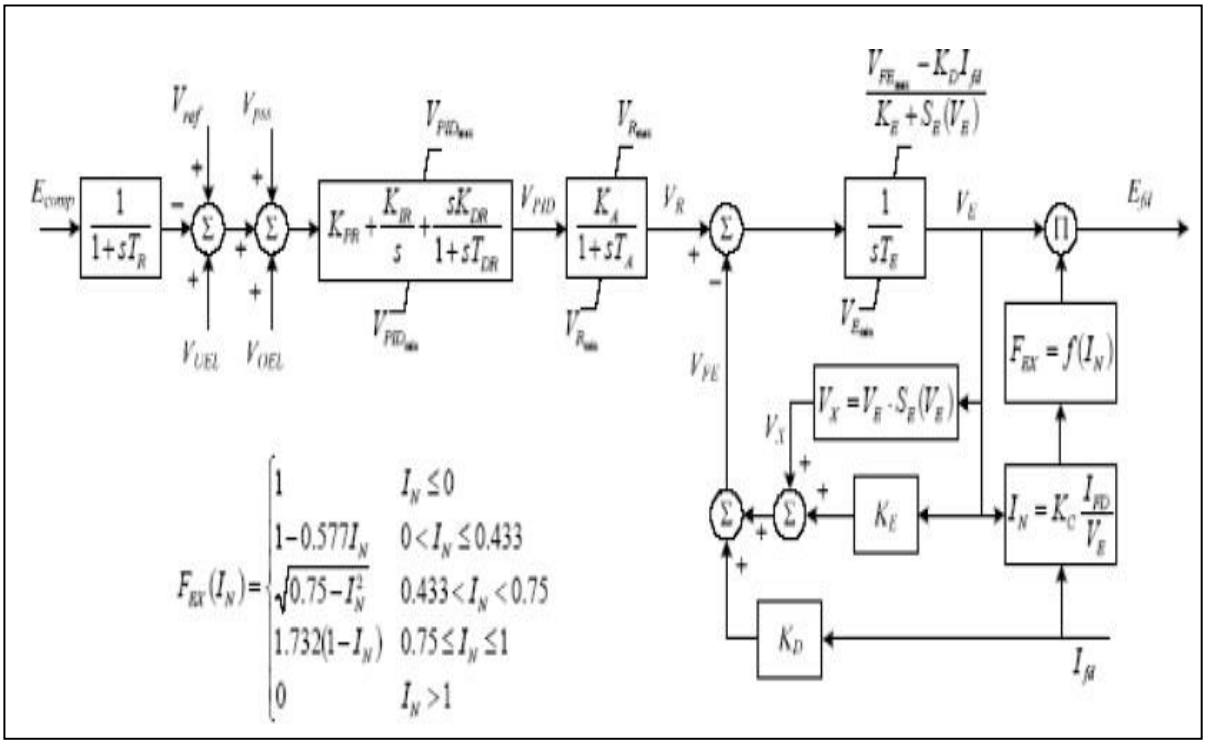
- **Type AC6A: IEEE 421.5 excitation system model**



- **Type AC7B: IEEE 421.5 2005 AC7B excitation system**

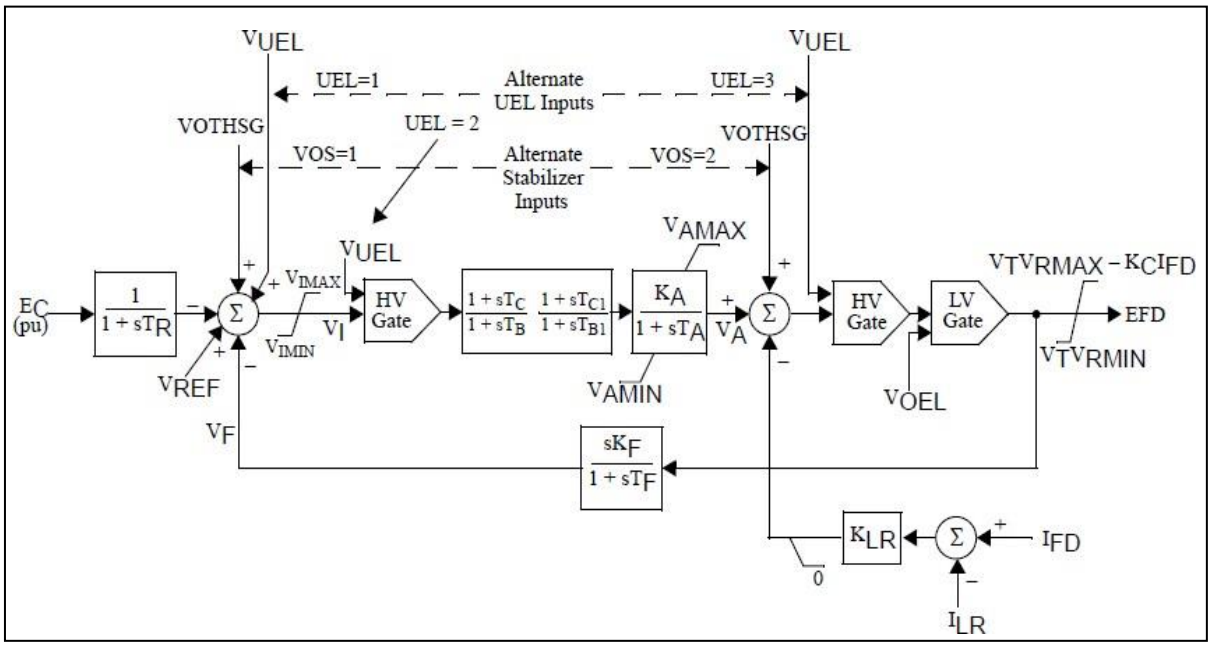


- **Type AC8B: IEEE 421.5 2005 AC8B excitation system**

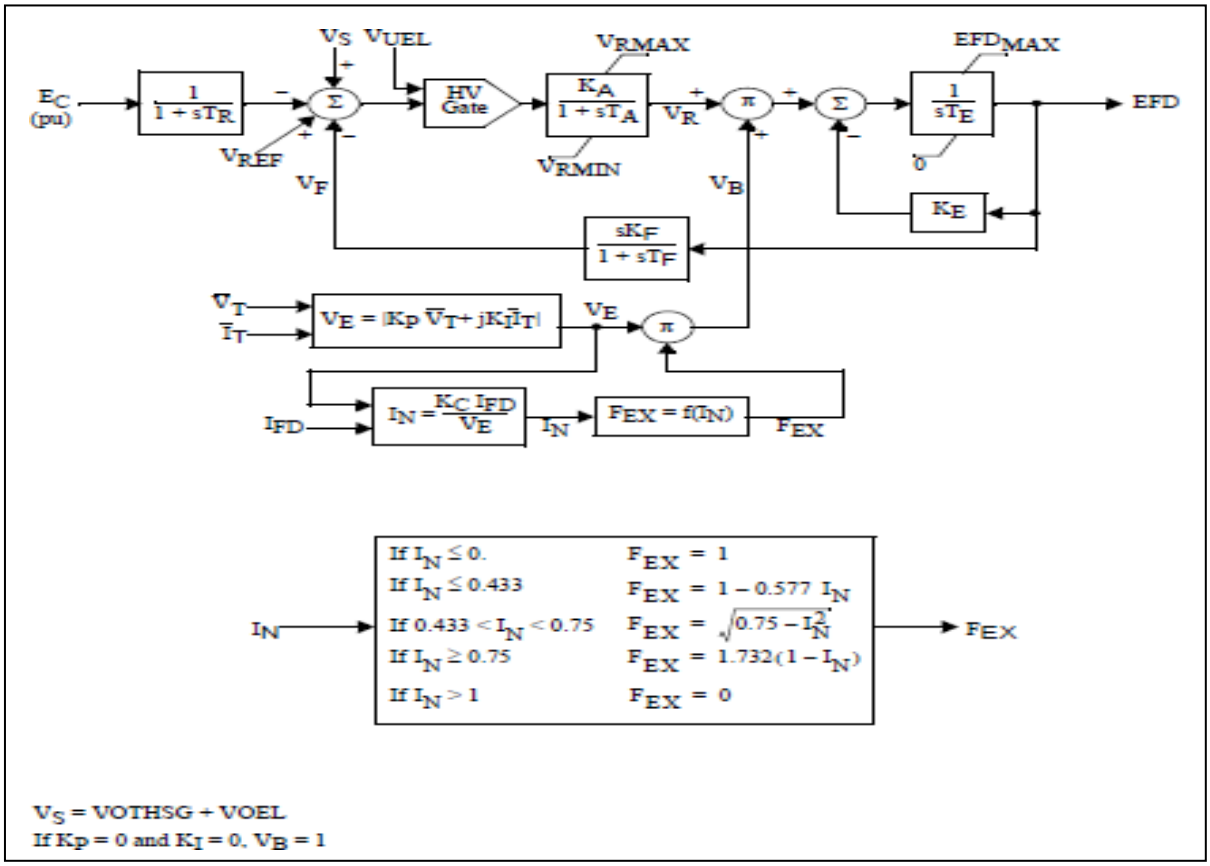


3. Commonly Used Static Exciters Generic Models block diagrams:

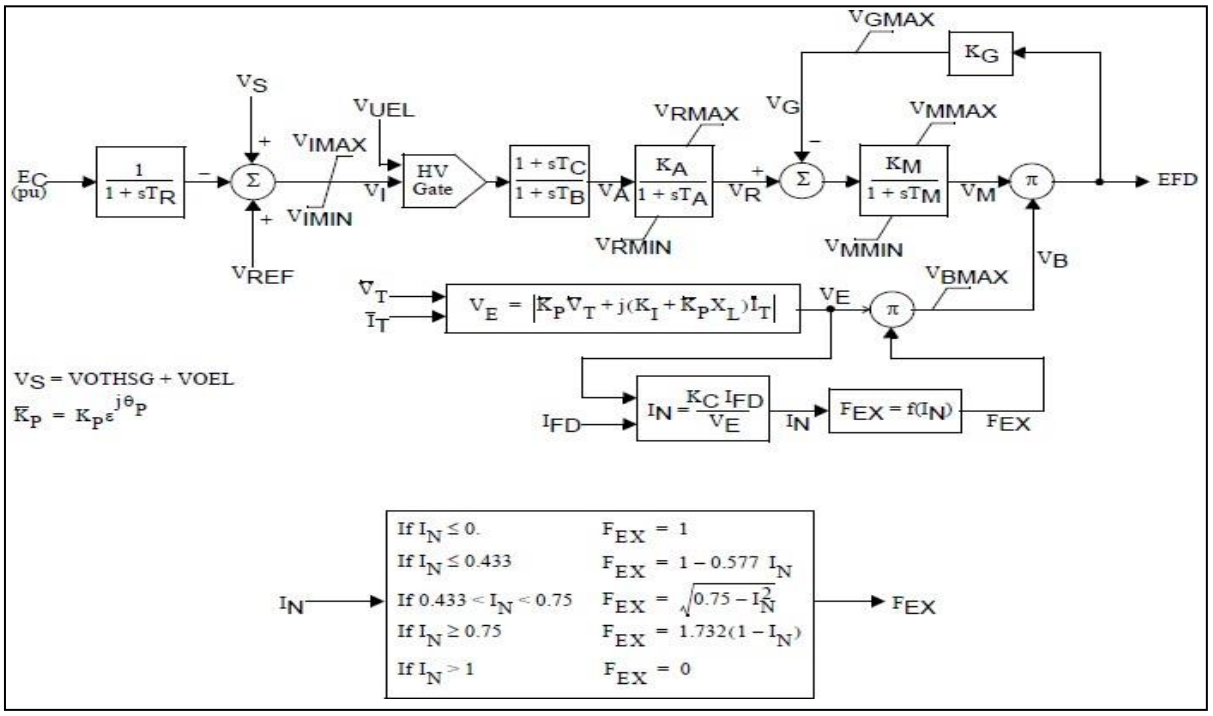
➢ Type ST1A: 1992 IEEE type ST1A excitation system model



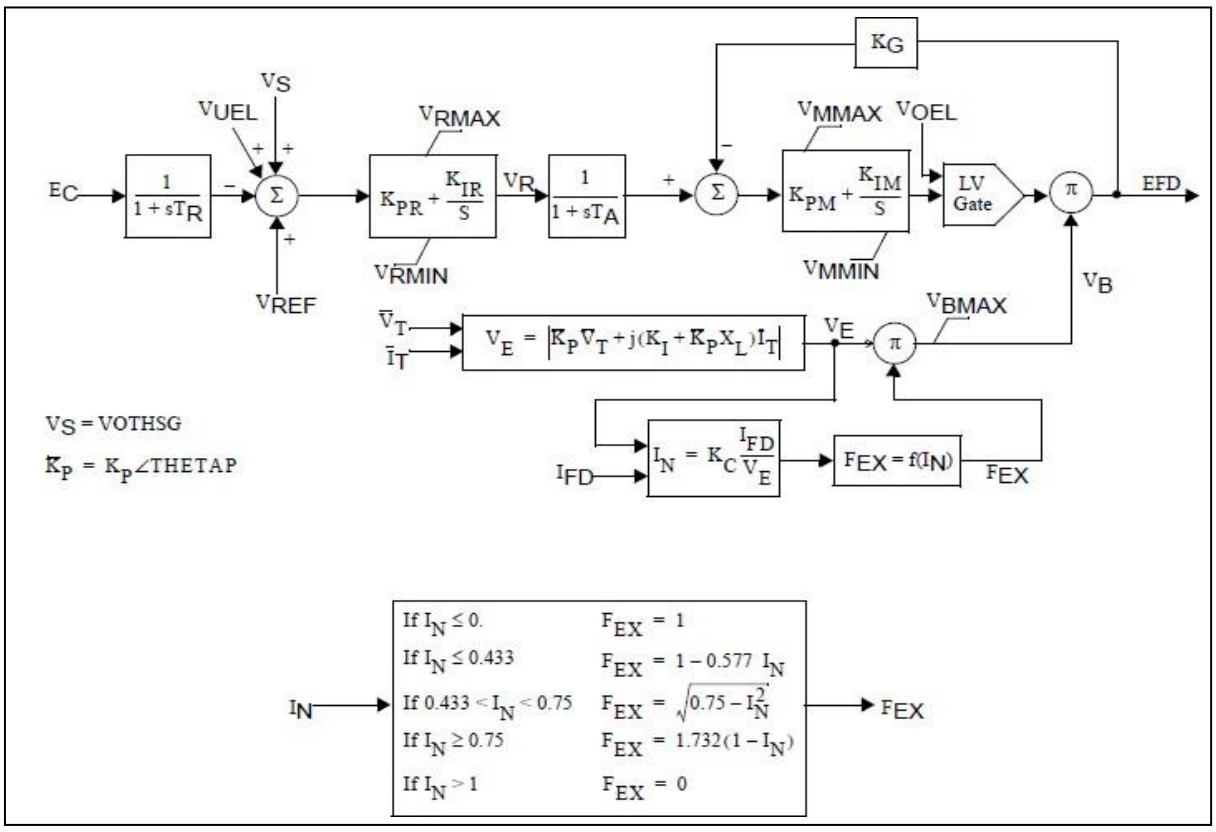
➢ Type ST2A: 1992 IEEE type ST2A excitation system model



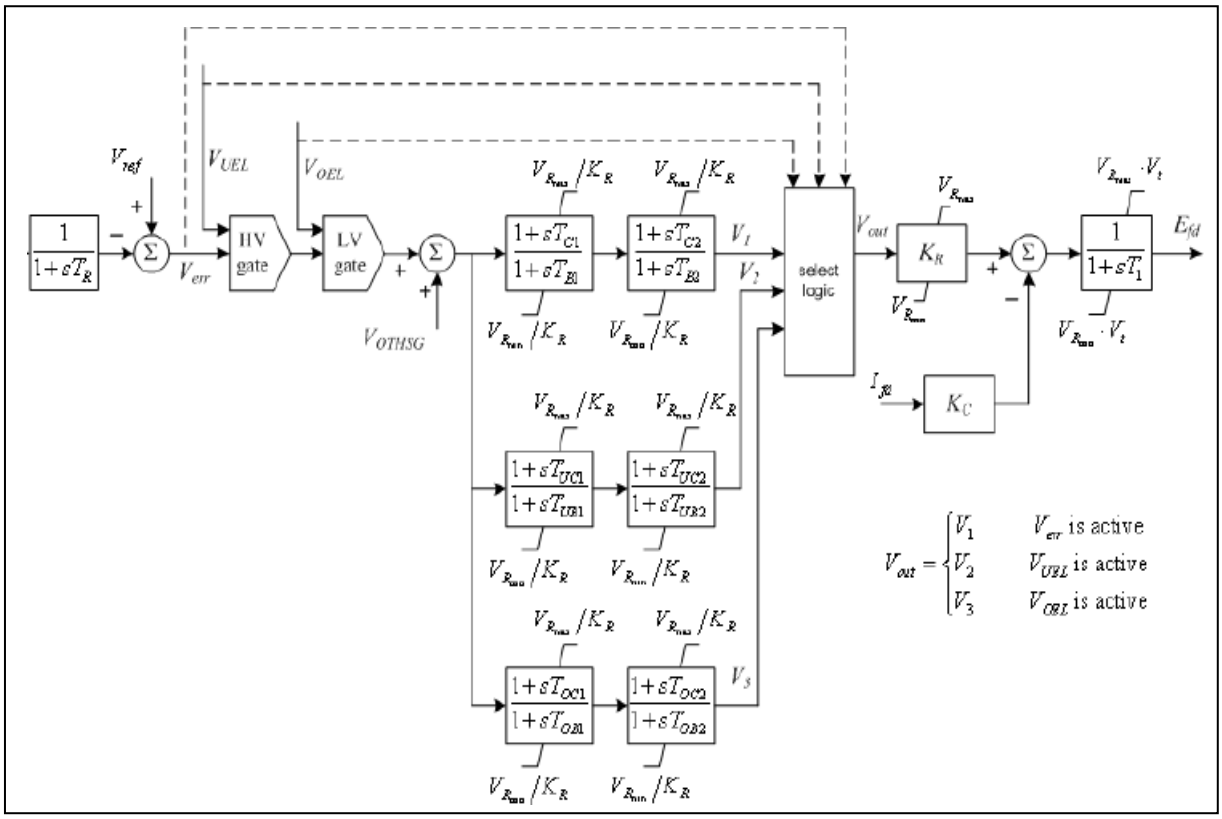
- **Type ST3A: 1992 IEEE type ST3A excitation system model**



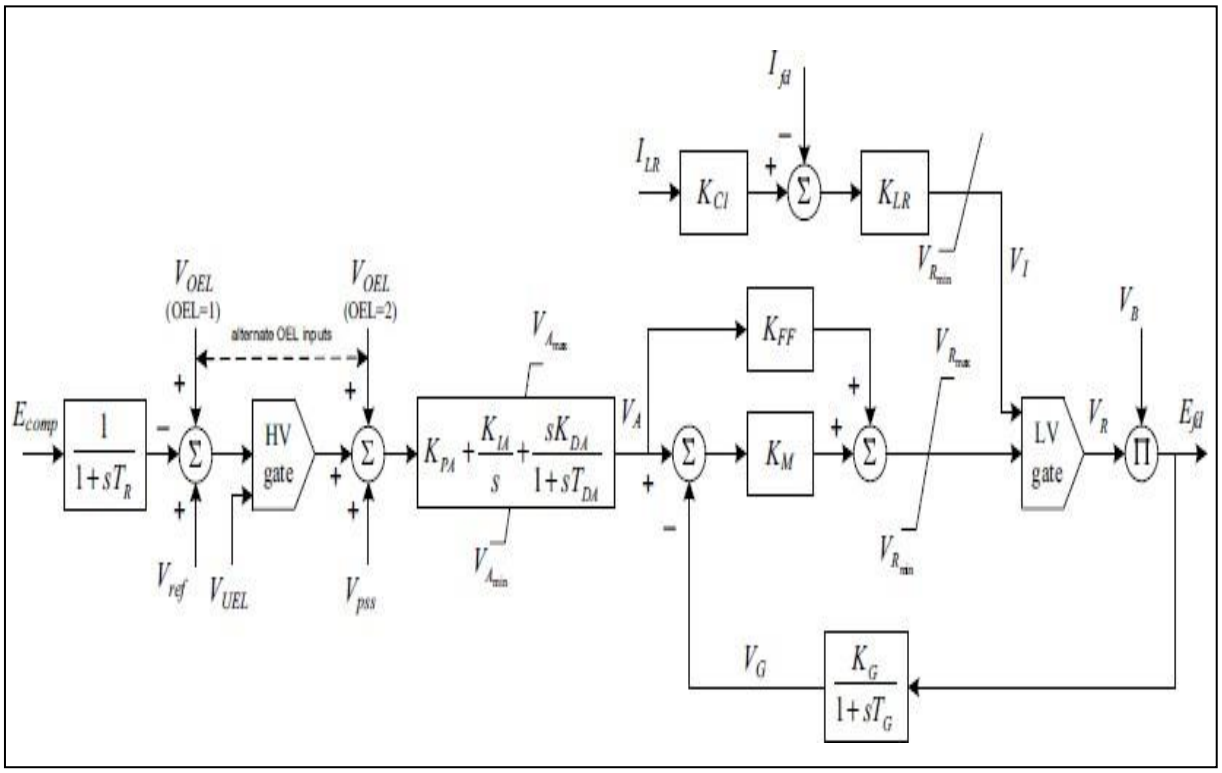
- **Type ST4B: IEEE type ST4B potential or compounded source-controlled rectifier exciter**



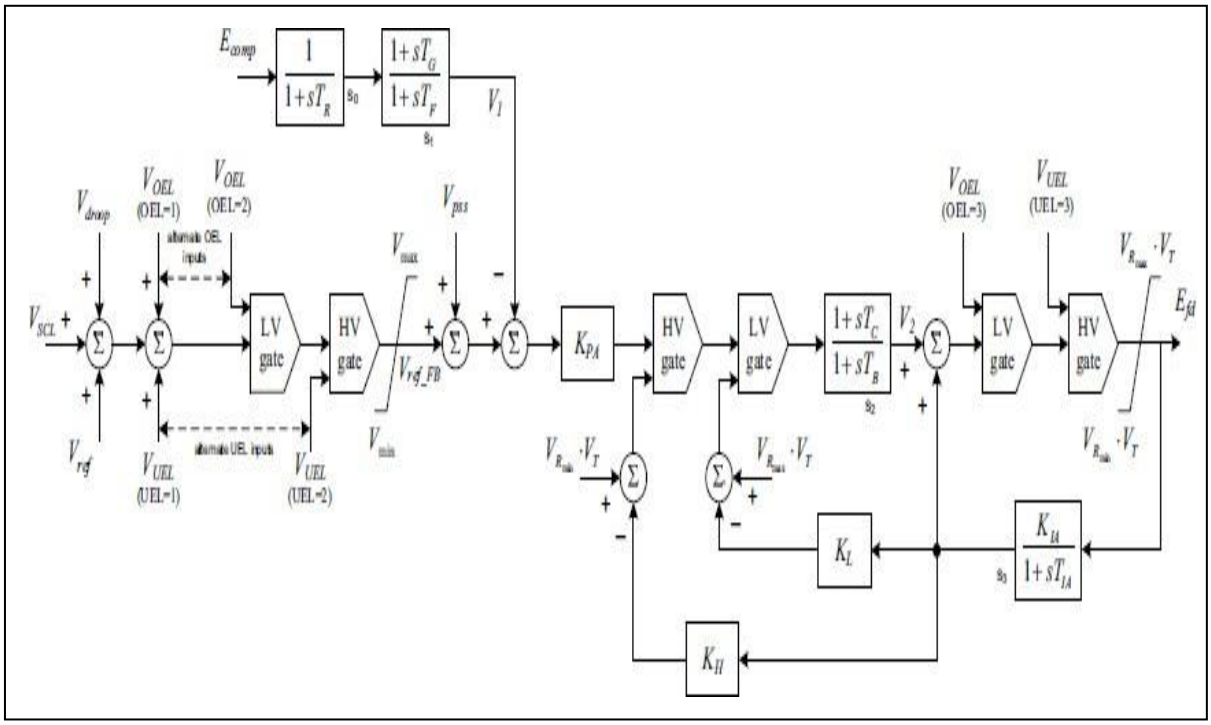
➢ Type ST5B: IEEE 421.5 2005 ST5B excitation system



➢ Type ST6B: IEEE 421.5 2005 ST6B excitation system

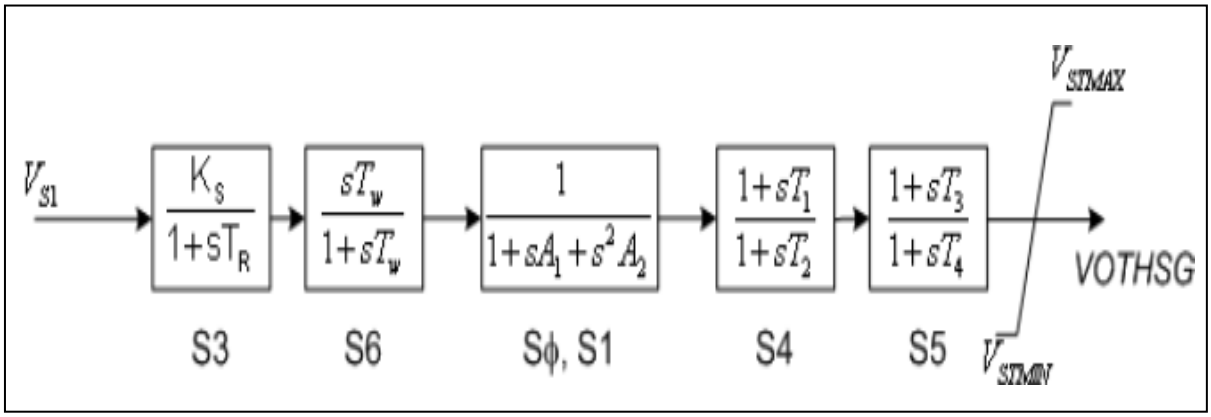


➢ Type ST7B: IEEE 421.5 2005 ST7B excitation system

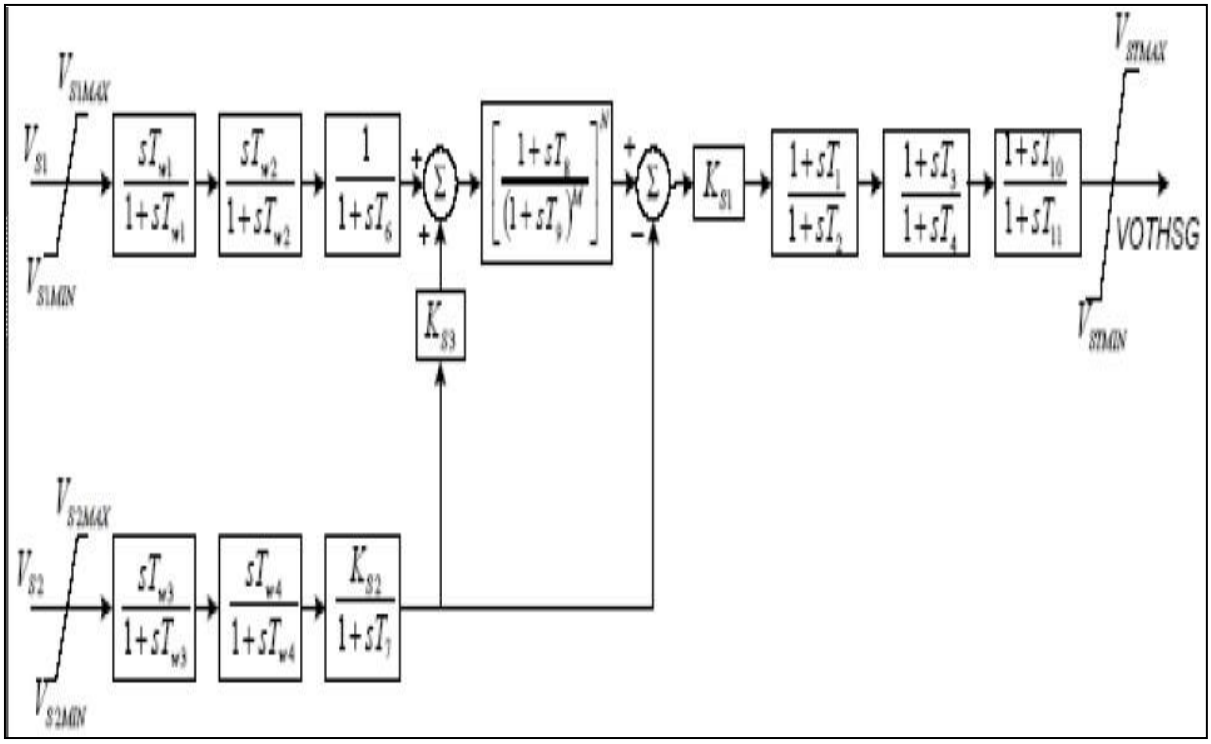


4. Commonly Used Power System Stabilizer generic models block diagrams:

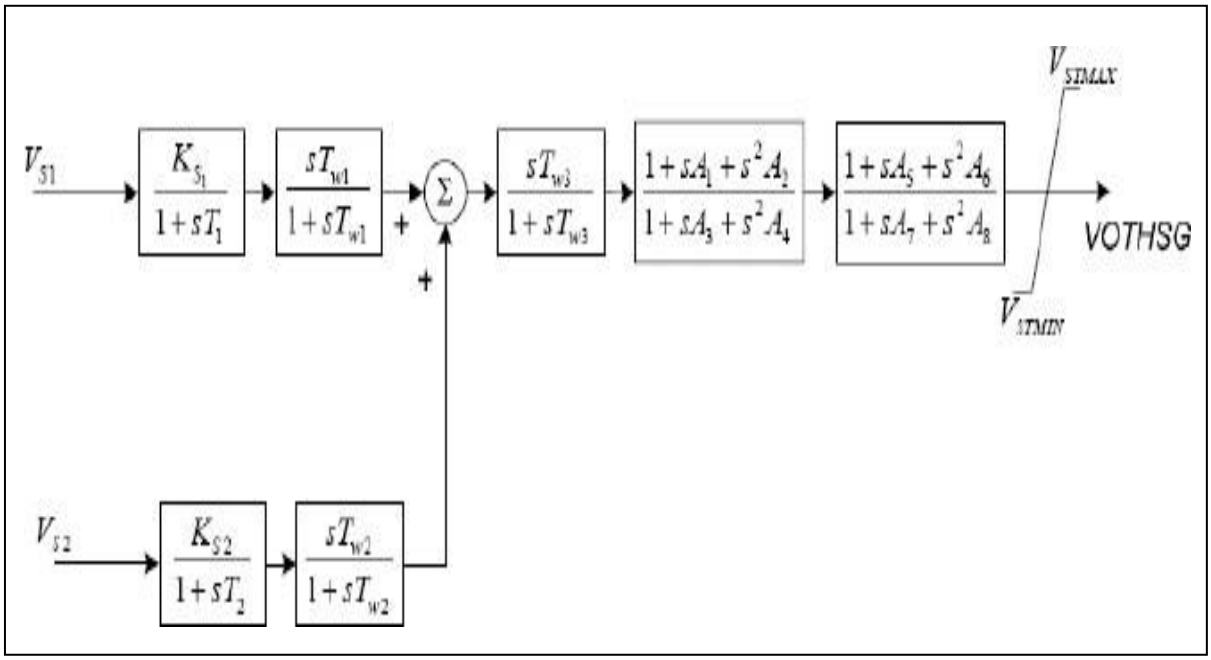
- **PSS1A: IEEE Std. 421.5-2005 PSS1A Single-Input Stabilizer model**



- **PSS2B: IEEE 421.5 2005 PSS2B IEEE dual-input stabilizer model**

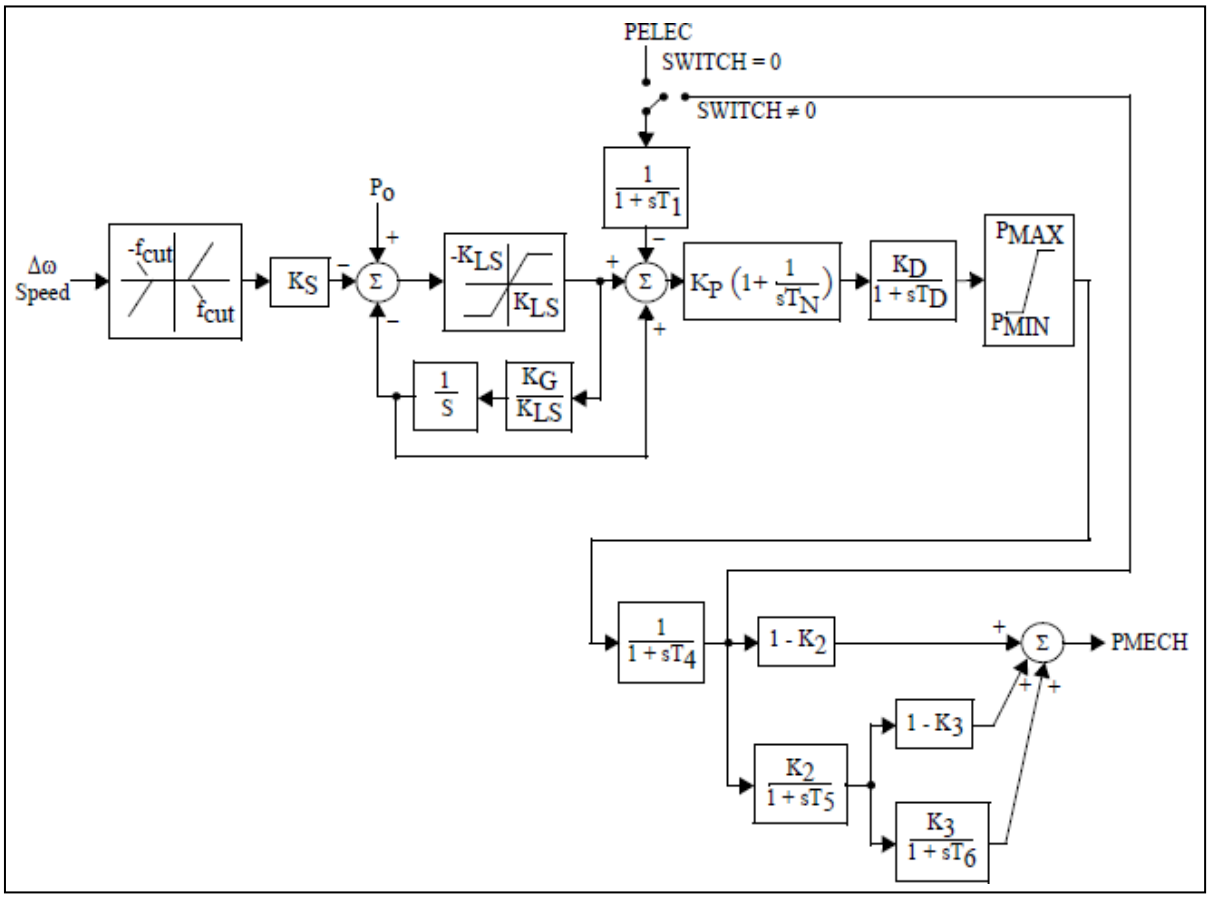


- **PSS3B: IEEE Std. 421.5 2005 PSS3B IEEE dual-input stabilizer model**

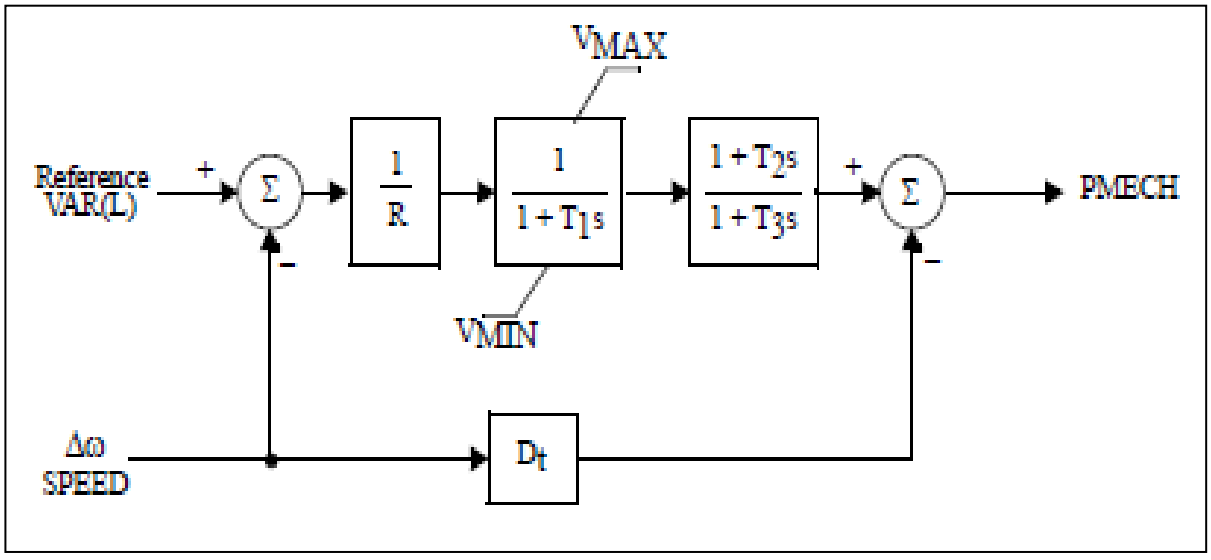


5. Commonly Used Steam Turbine Generic Models Block Diagrams:

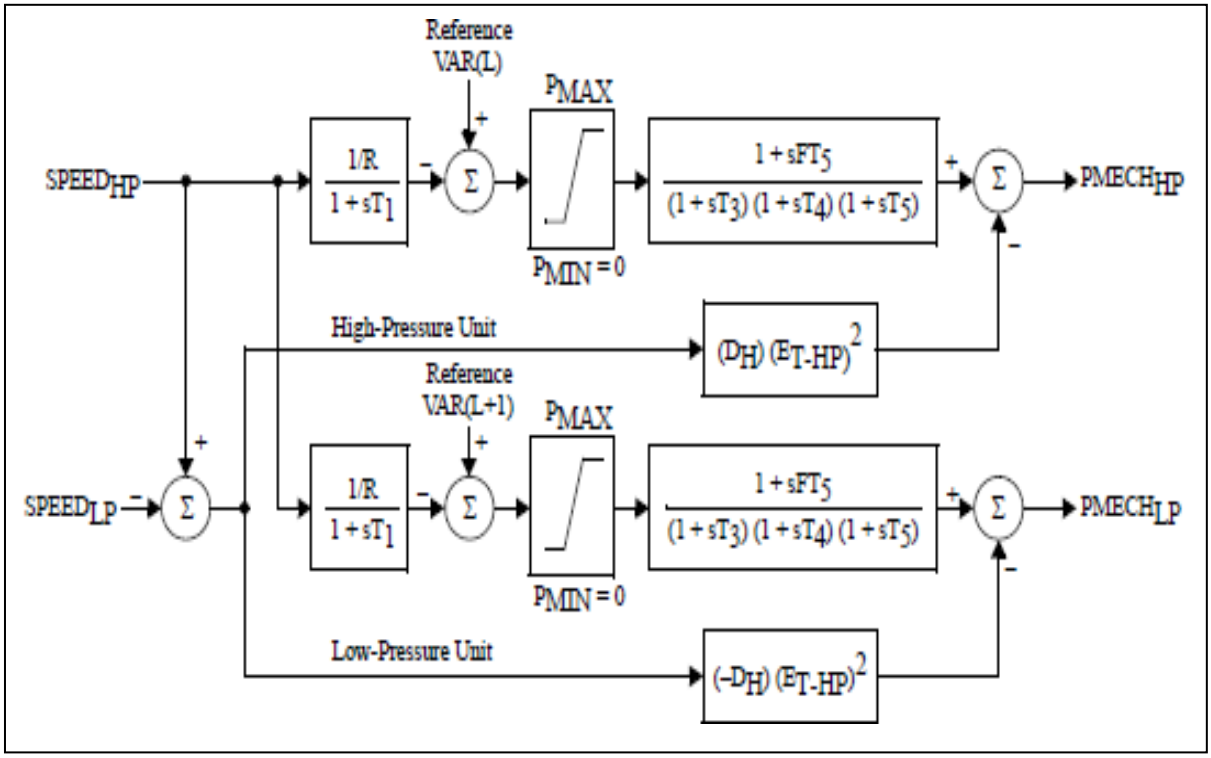
➢ BBGOV1: Brown-Boveri turbine-governor model



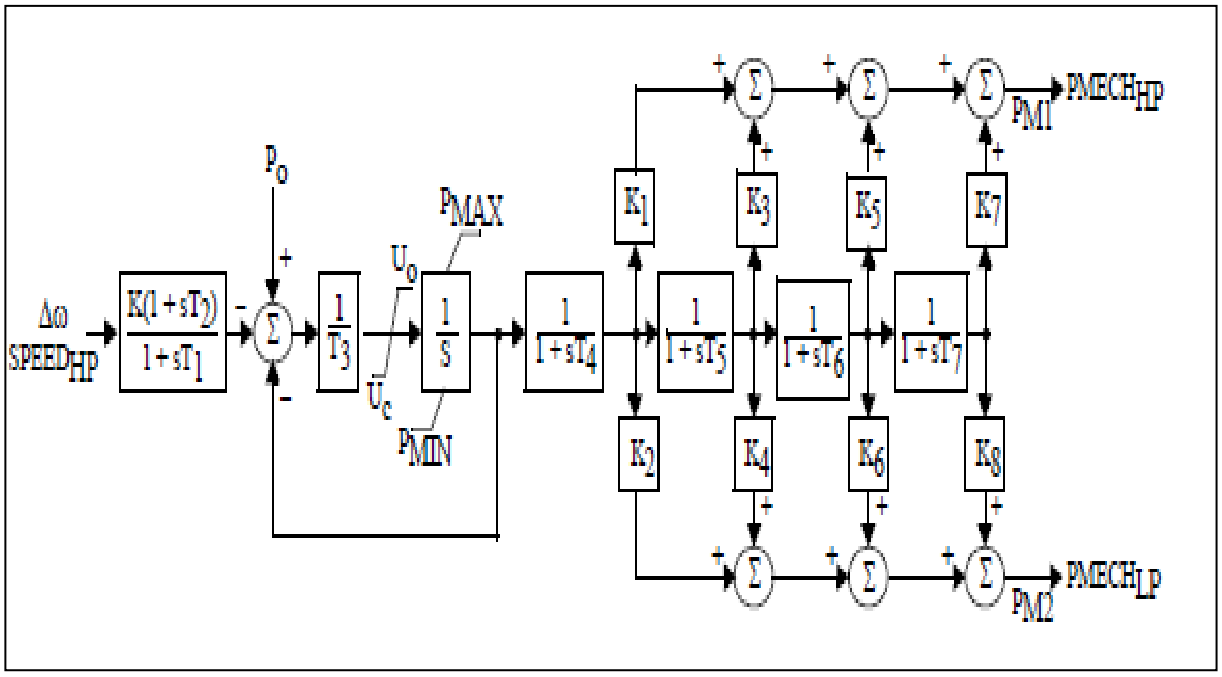
➢ TGOV1: Steam turbine-governor model



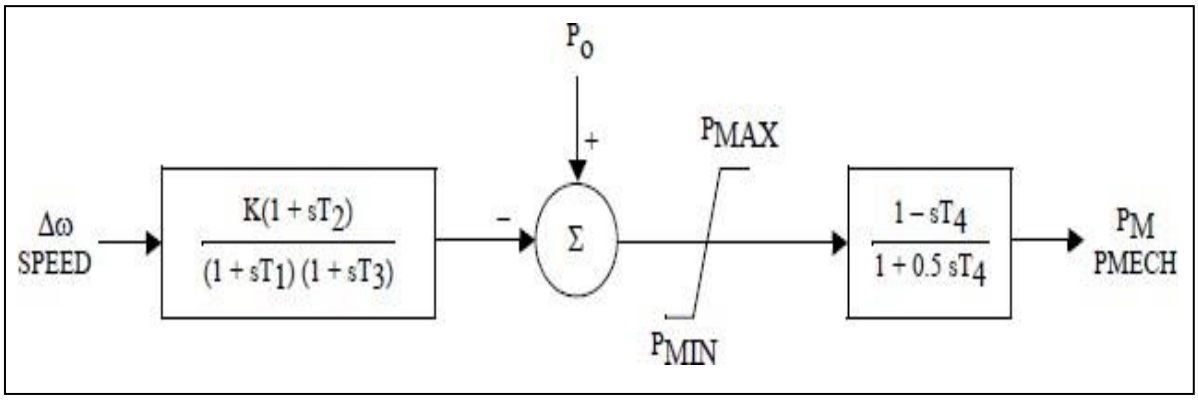
- **CRCMGV: Cross compound turbine-governor model**



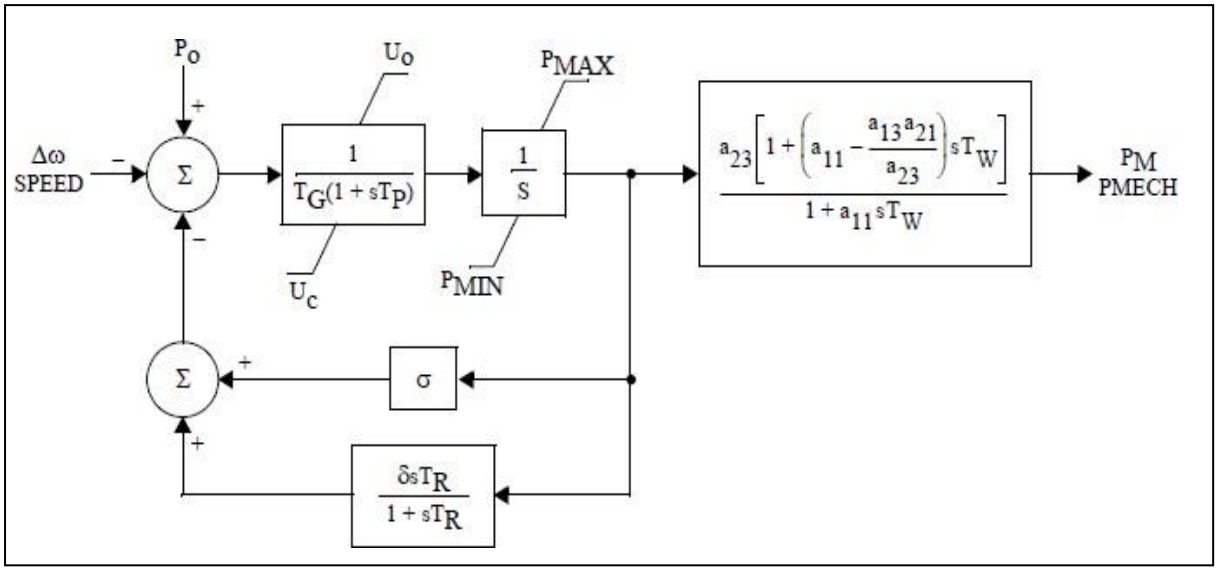
- **IEEEG1: 1981 IEEE type 1 turbine-governor model**



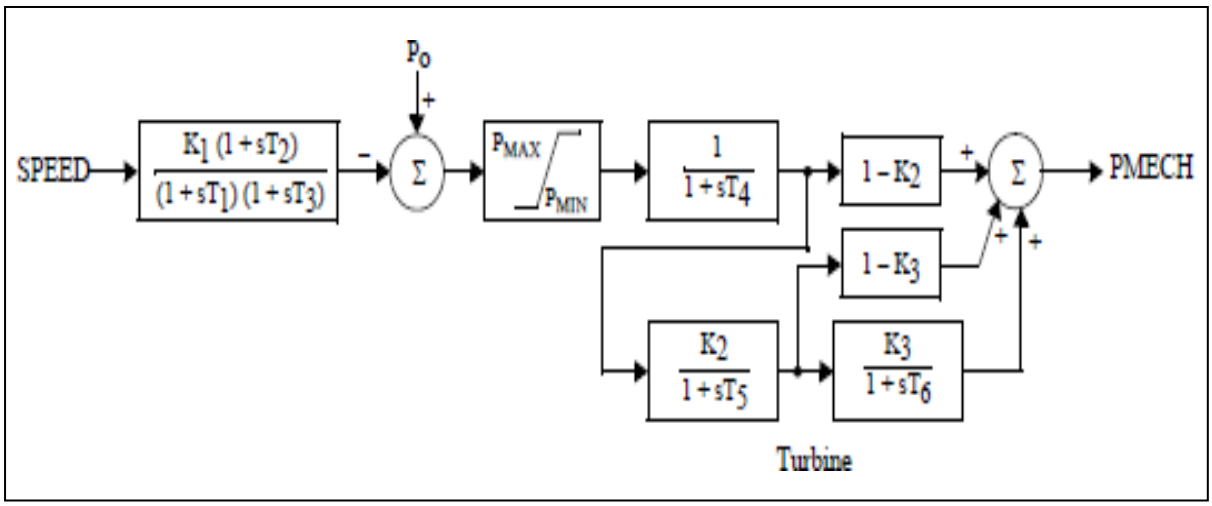
- **IEEEG2: 1981 IEEE Type 2 Speed-Governing Model**



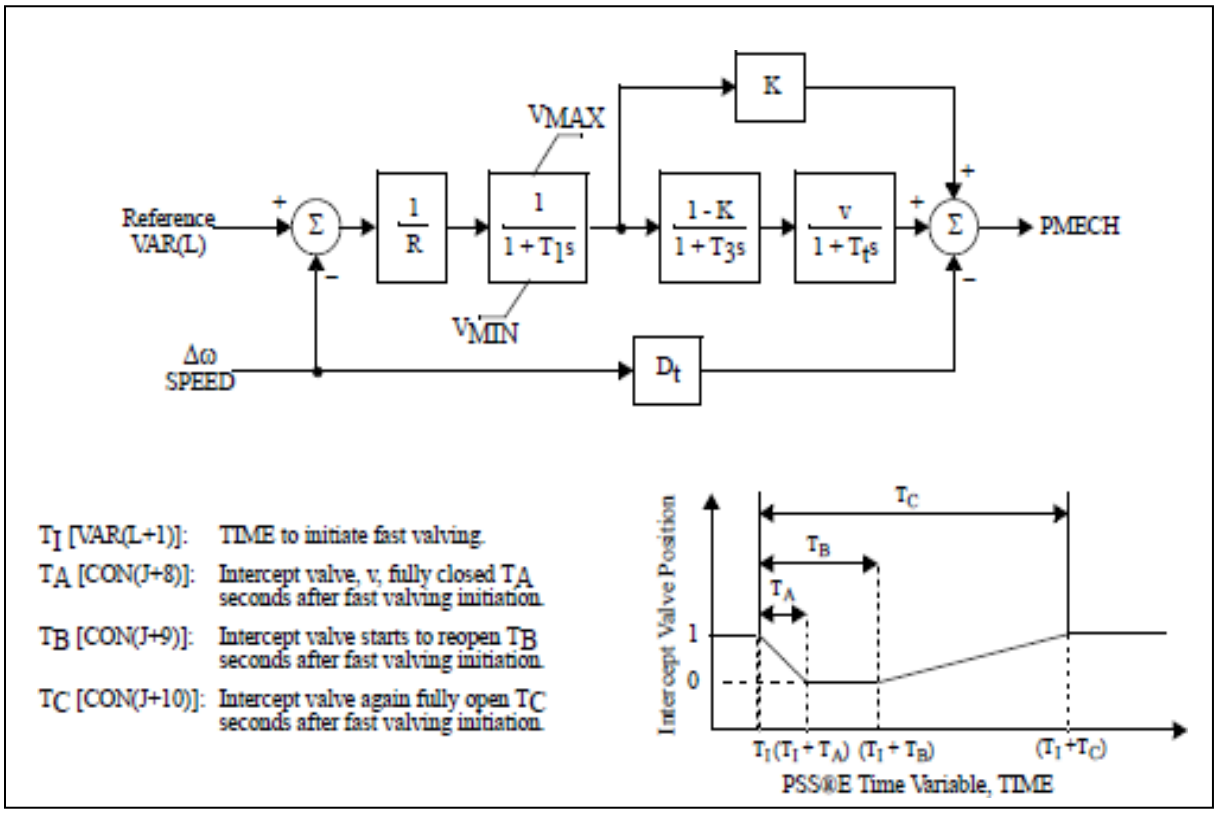
- **IEEEG3: 1981 IEEE Type 3 Speed-Governing Model**



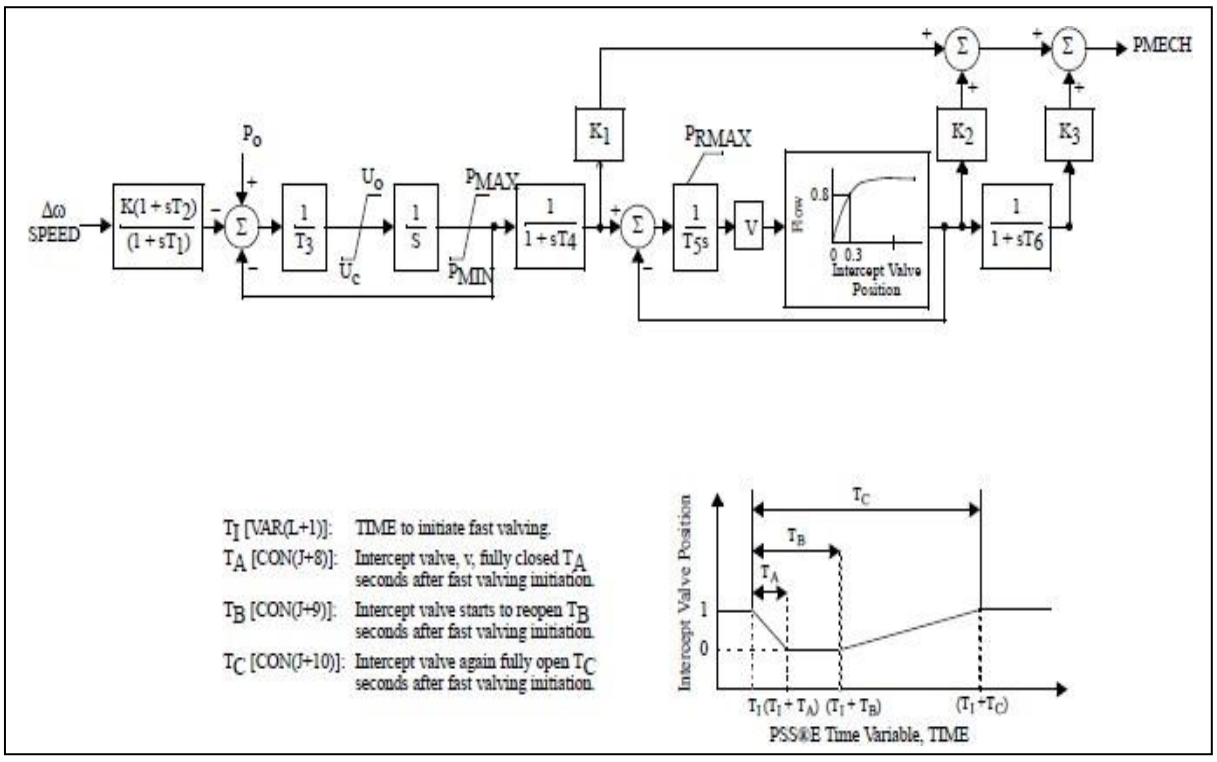
- **IEESGO: 1973 IEEE standard turbine-governor model**



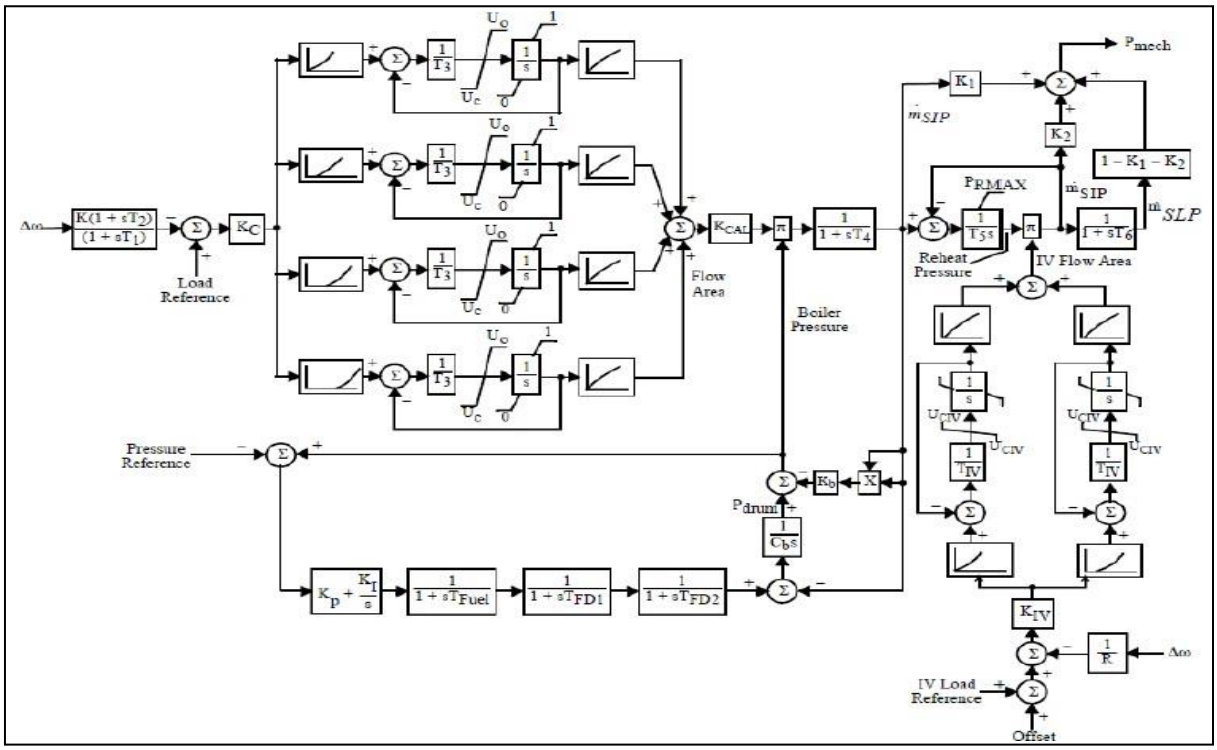
➢ TGOV2: Steam turbine-governor model with fast valving



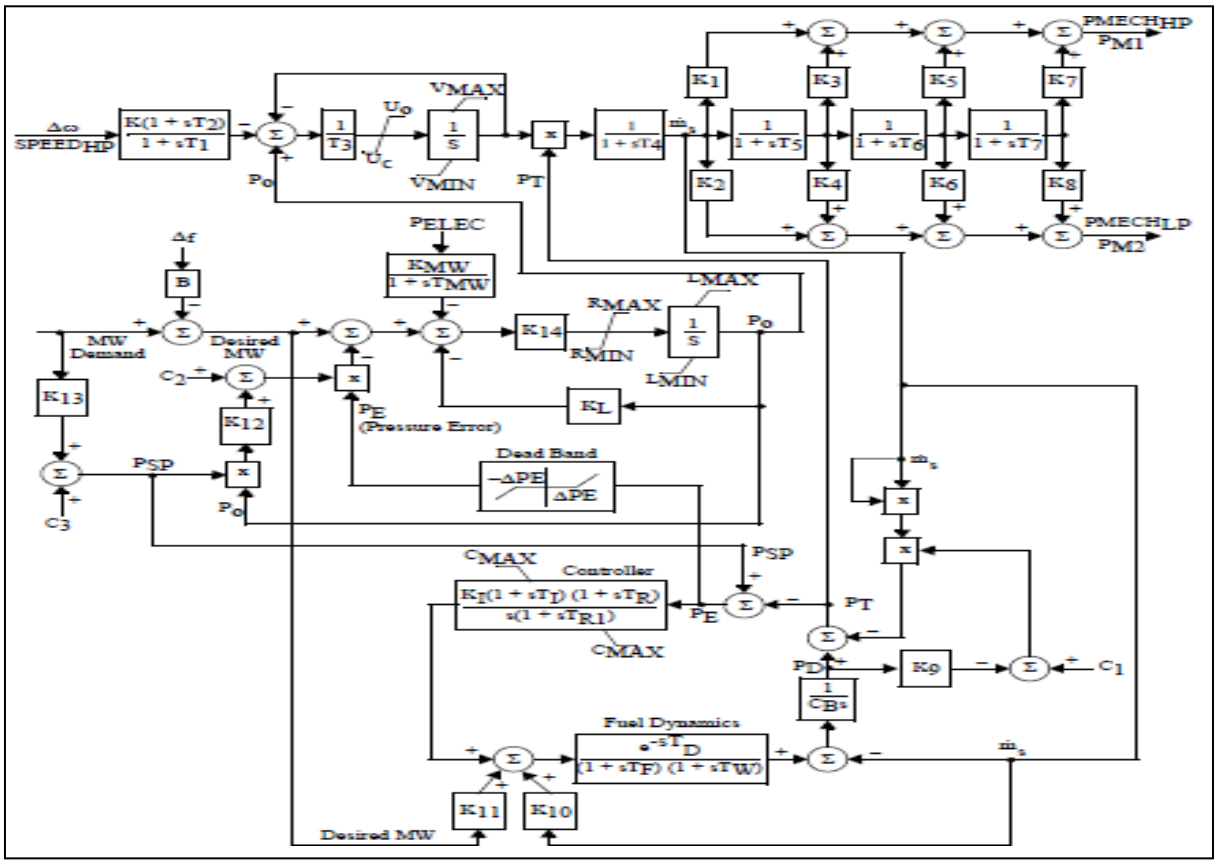
➢ TGOV3: Modified IEEE type 1 turbine-governor model with fast valving



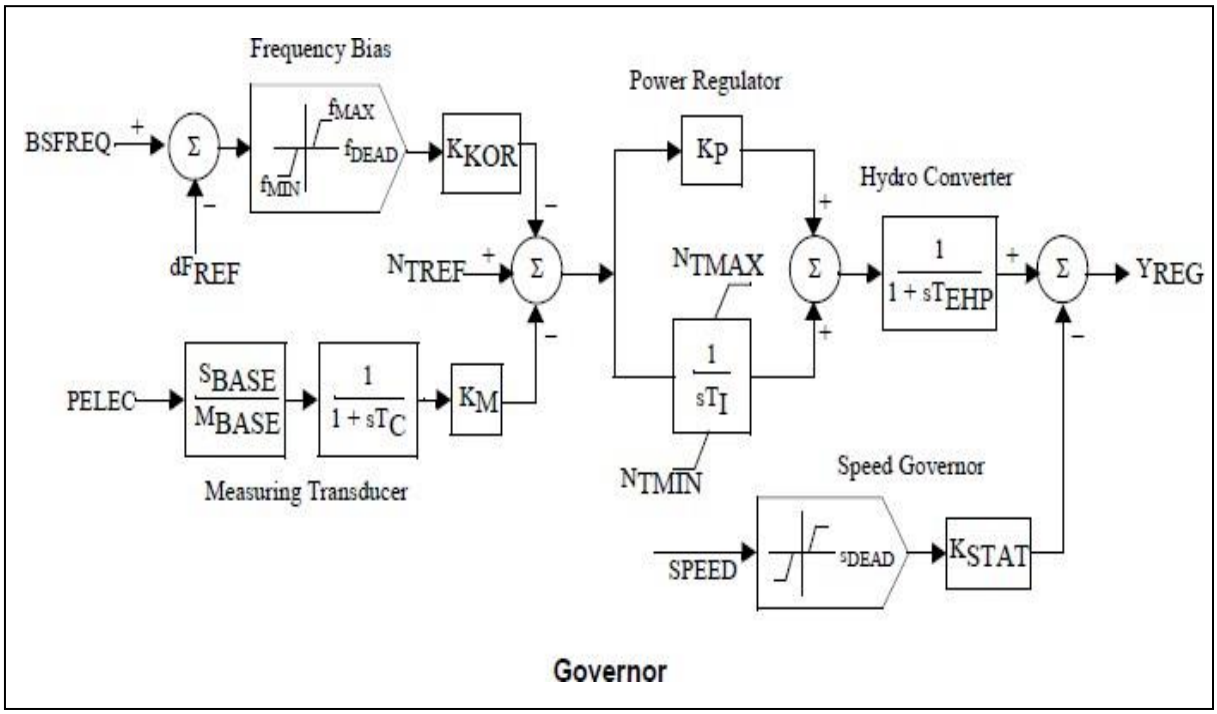
➢ TGOV4: Modified IEEE type 1 speed governing model with PLU and EVA



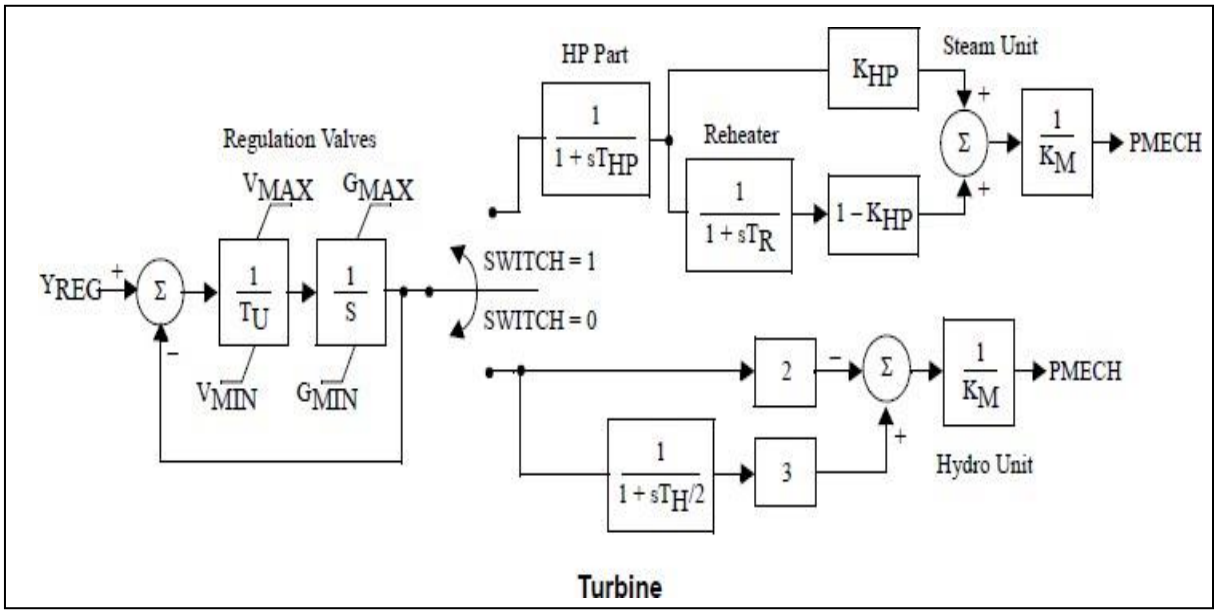
➢ TGOV5: Modified IEEE type 1 turbine-governor model with boiler controls



➢ TURCZT: Czech Hydro and Steam Governor

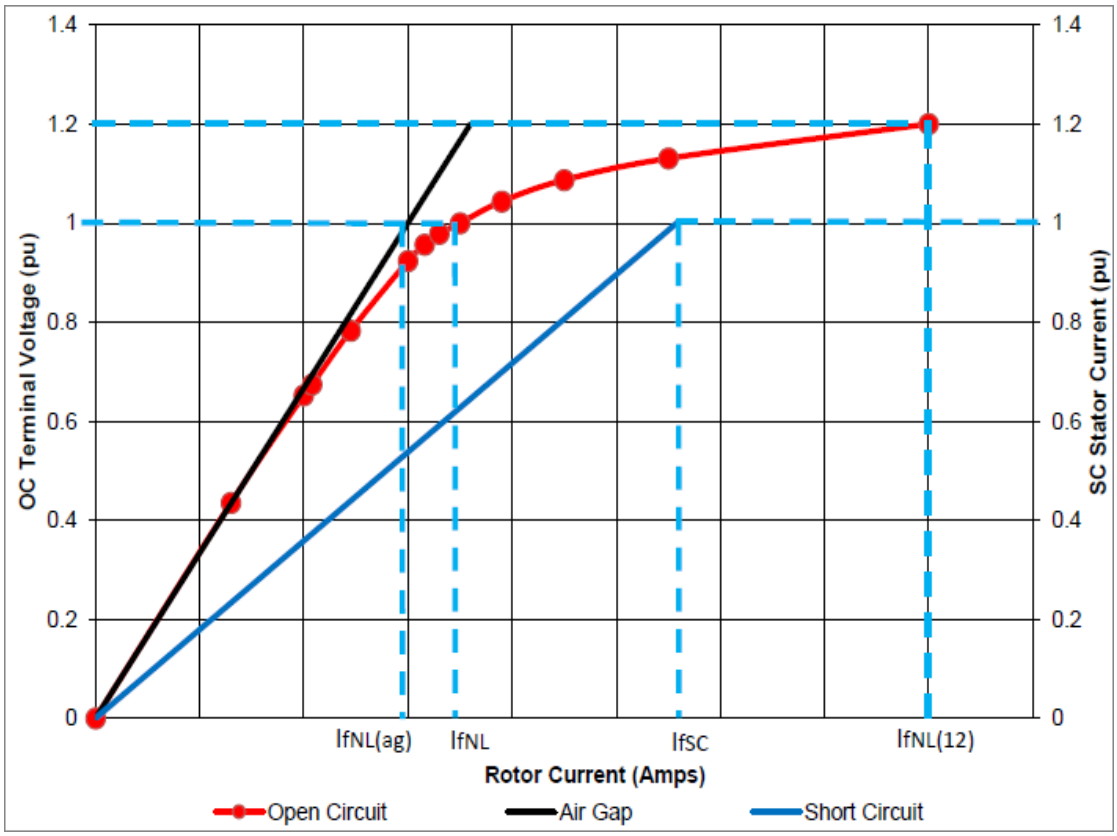


Governor



Turbine

- **Calculation of saturation parameters:**



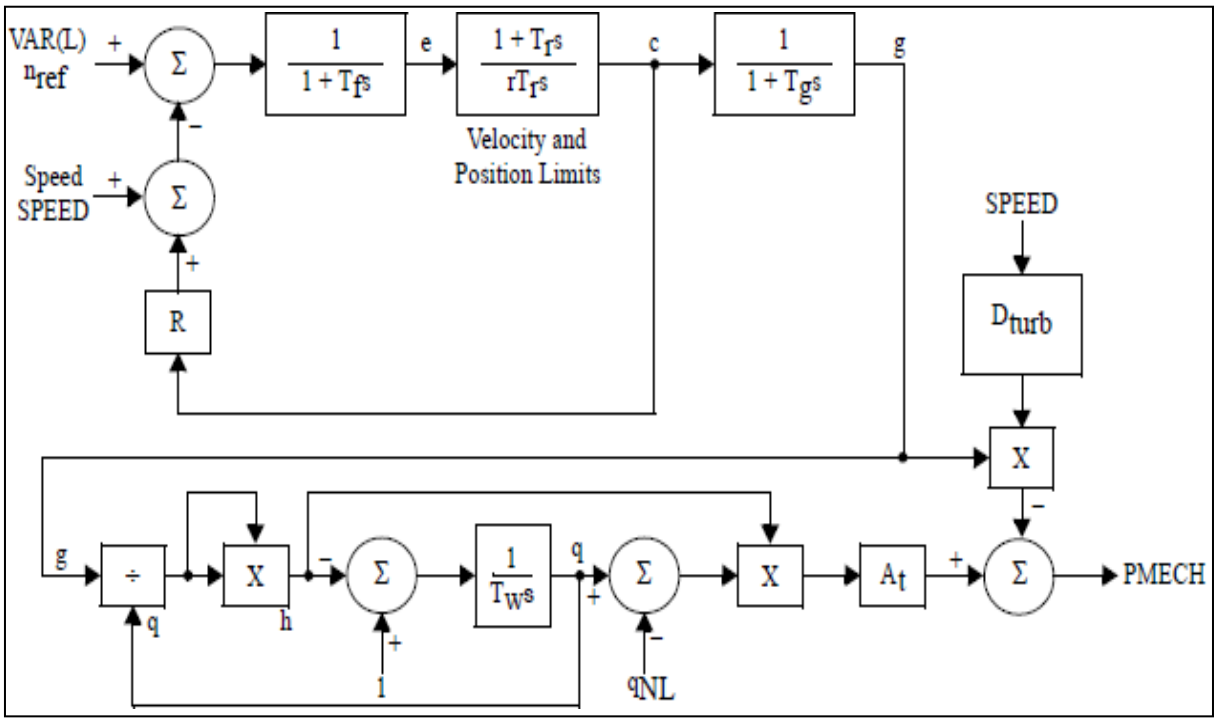
The saturation can be calculated using the following calculation:

$$S(1.0) = \frac{If_{NL} - If_{NL(AG)}}{If_{NL(AG)}}$$

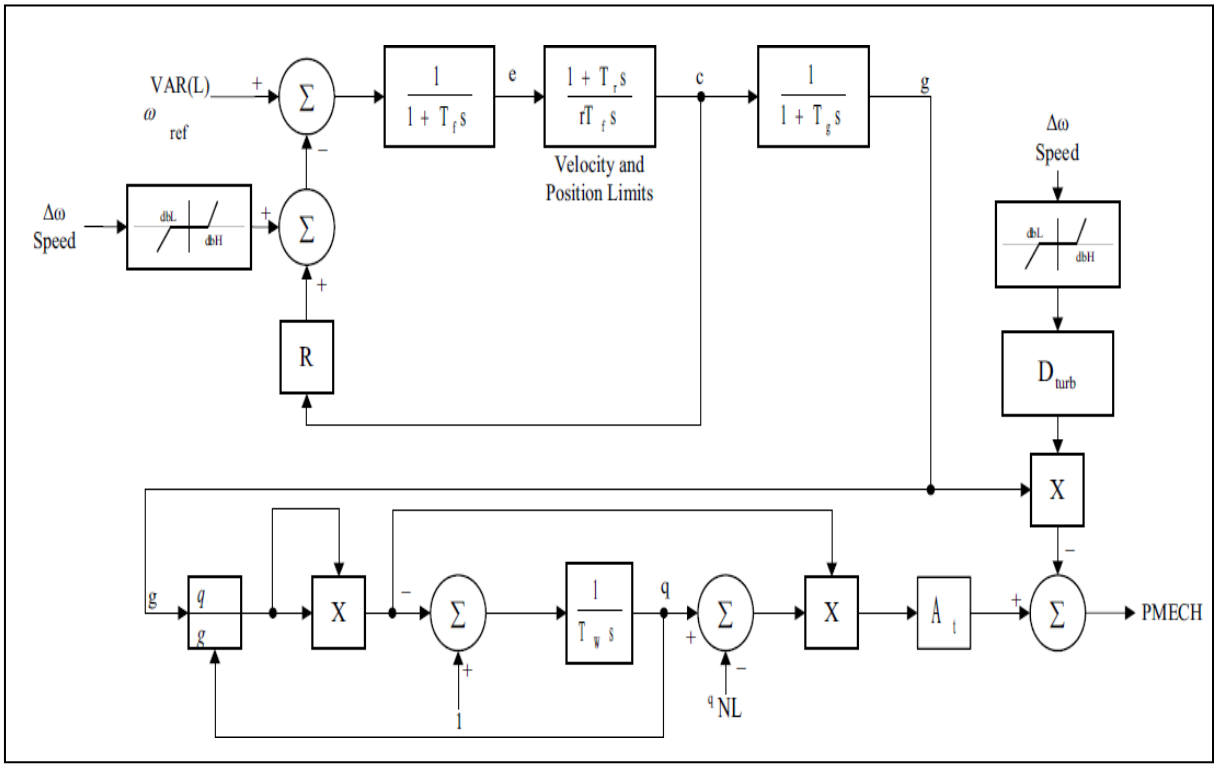
$$S(1.2) = \frac{If_{NL(12)} - 1.2 \times If_{NL(AG)}}{1.2 \times If_{NL(AG)}}$$

6. Commonly Used Hydro Turbine Generic Model Block Diagrams:

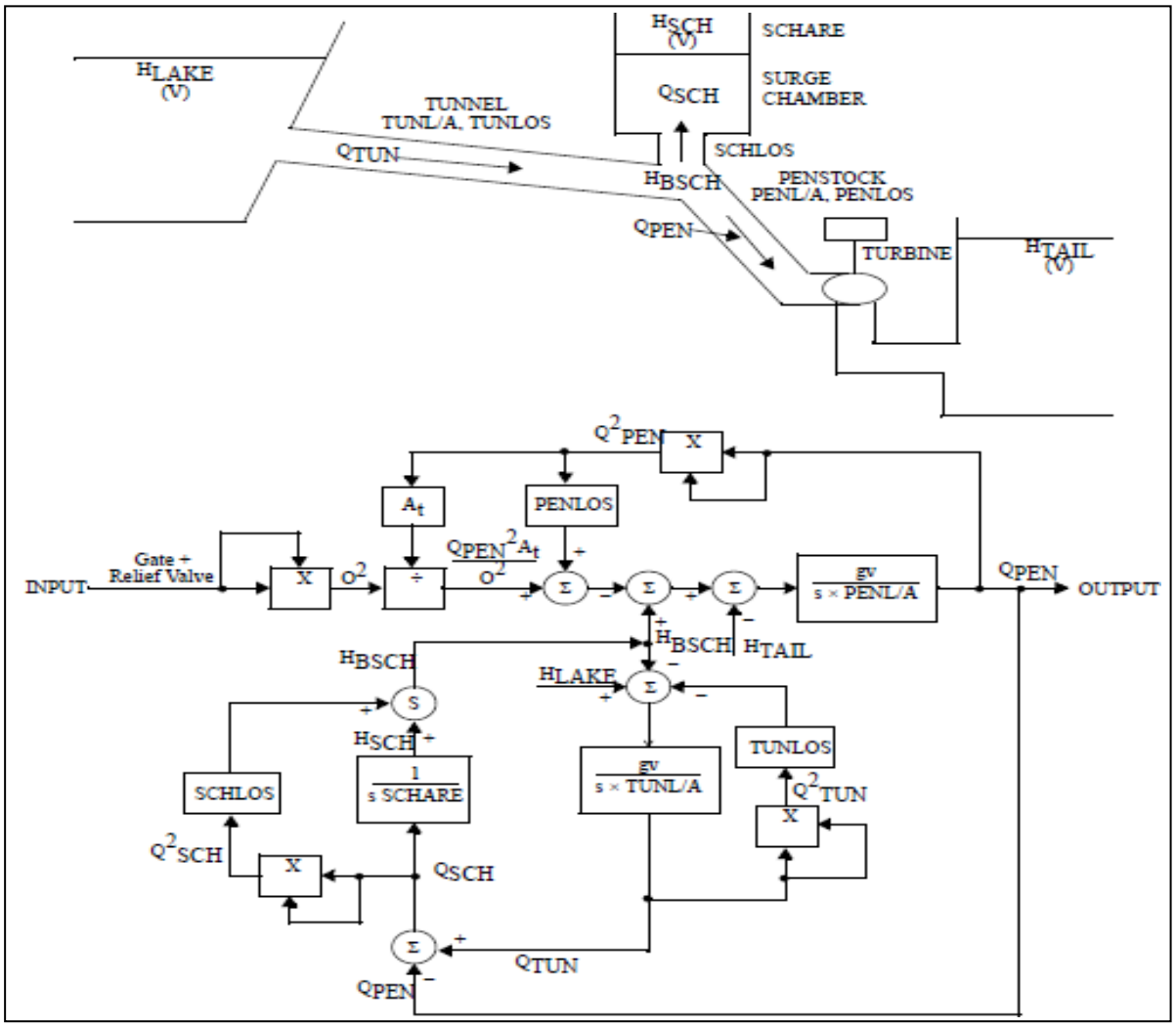
➢ HYGOV: Hydro Turbine-Governor



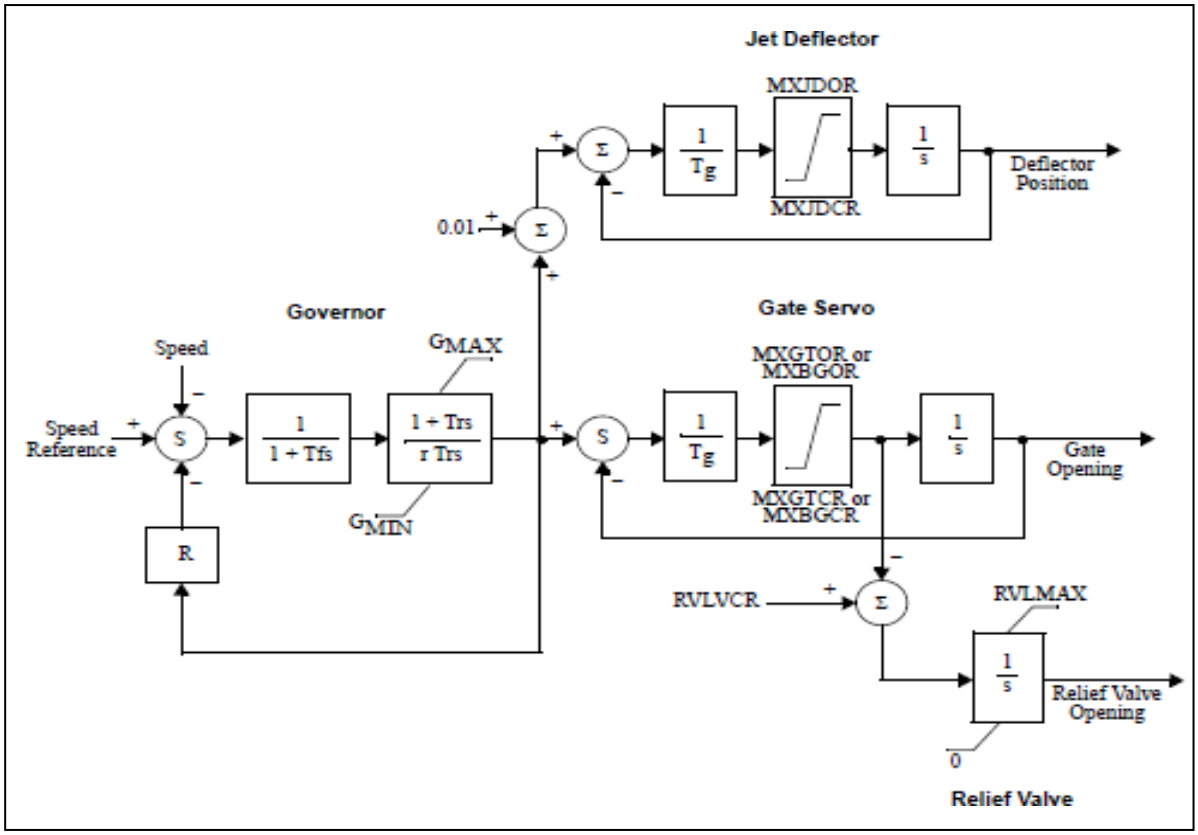
➢ HYGOVDU: Hydro Turbine-Governor



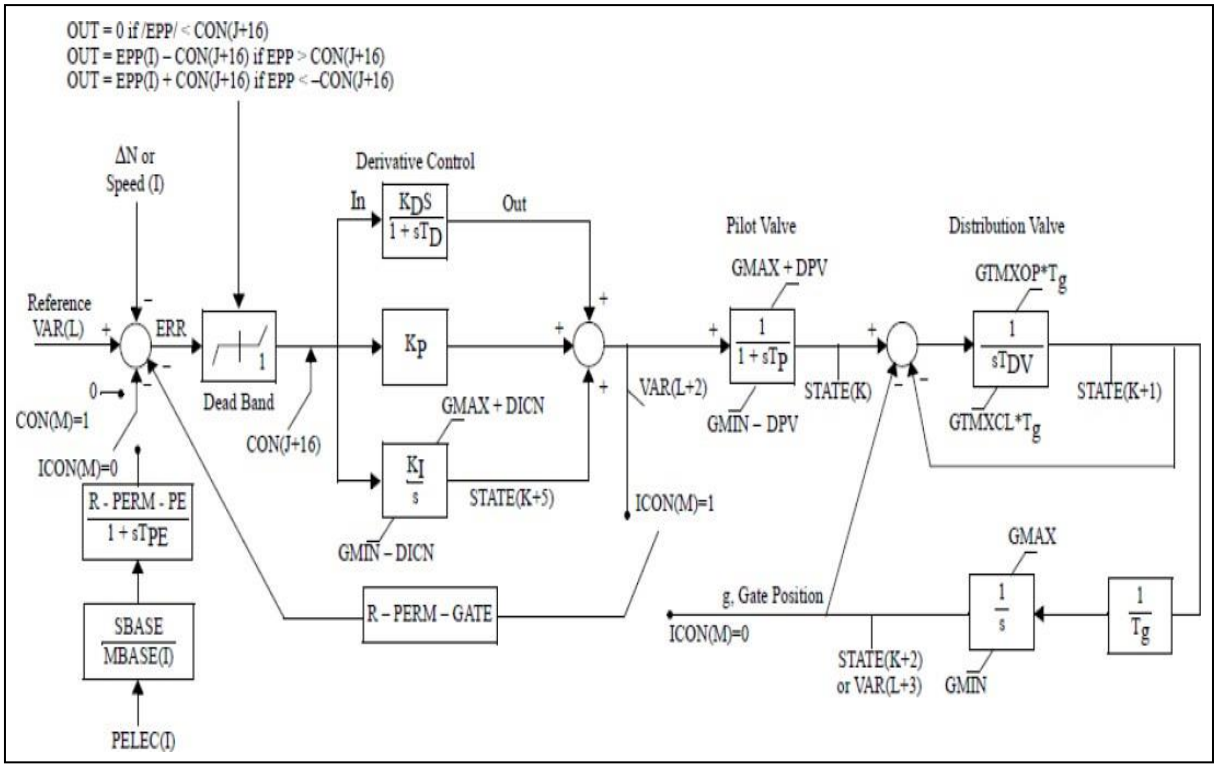
➢ HYGOVM: Hydro Turbine-Governor Lumped Parameter Model



gv	Gravitational acceleration	A_t	Turbine flow gain
TUNL/A	Summation of length/cross section of tunnel	O	Gate + relief valve opening
SCHARE	Surge chamber cross section	HSCH	Water level in surge chamber
PENLOS	Penstock head loss coefficient	QPEN	Penstock flow
TUNLOS	Tunnel head loss coefficient	QTUN	Tunnel flow
FSCH	Surge chamber orifice head loss coefficient	QSCH	Surge chamber flow
PENL/A	Summation of length/cross section of penstock, scroll case and draft tube		

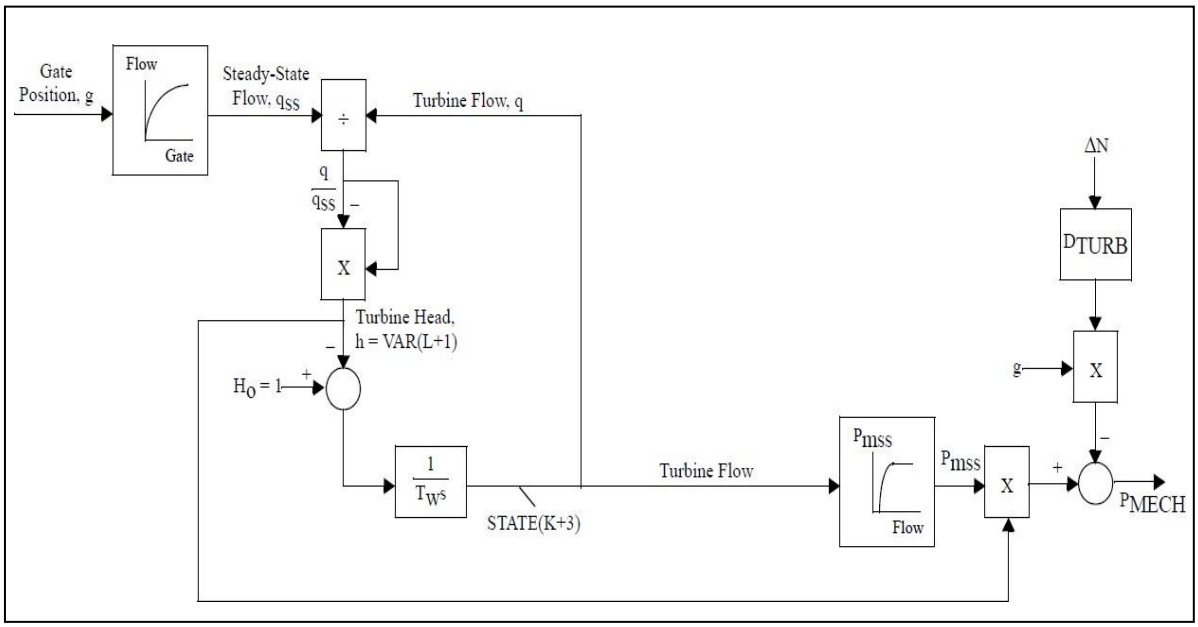


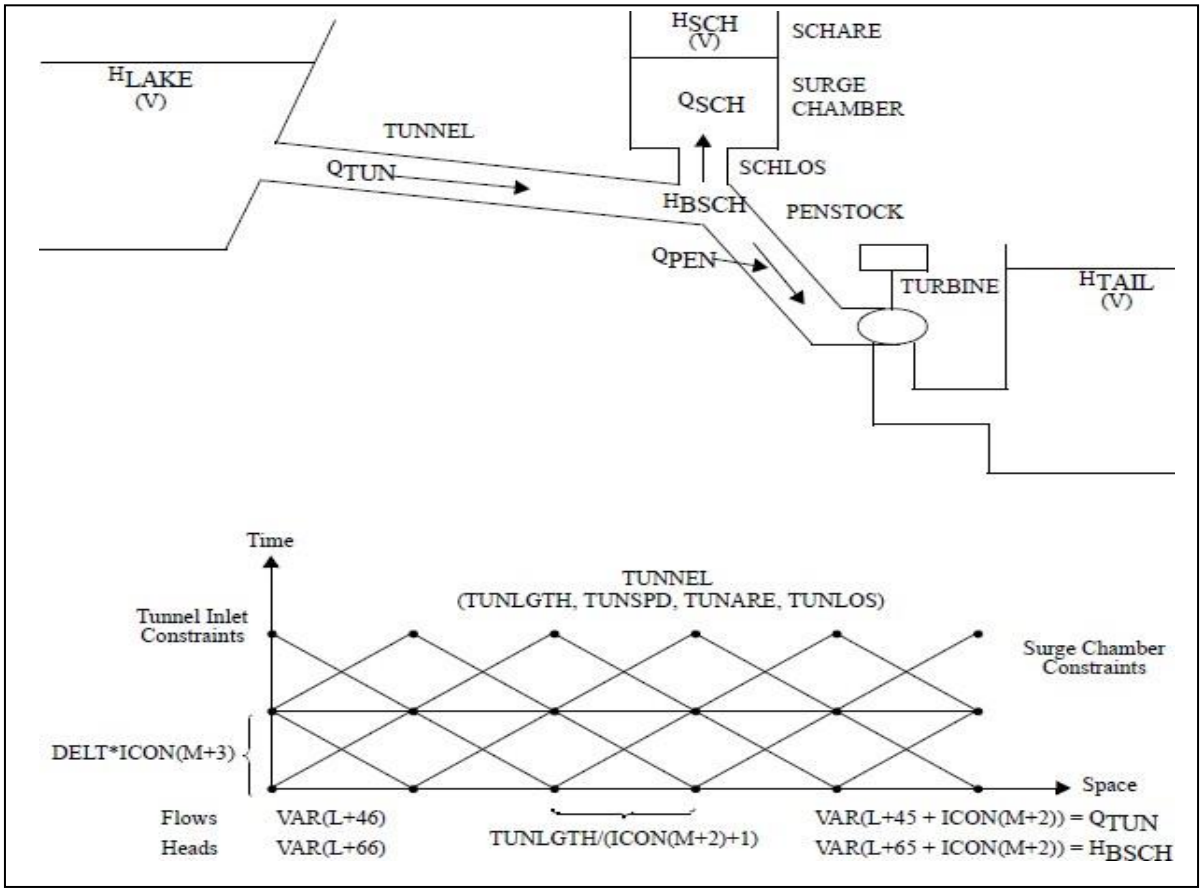
➢ WEHGOV: Woodward Electric Hydro Governor Model

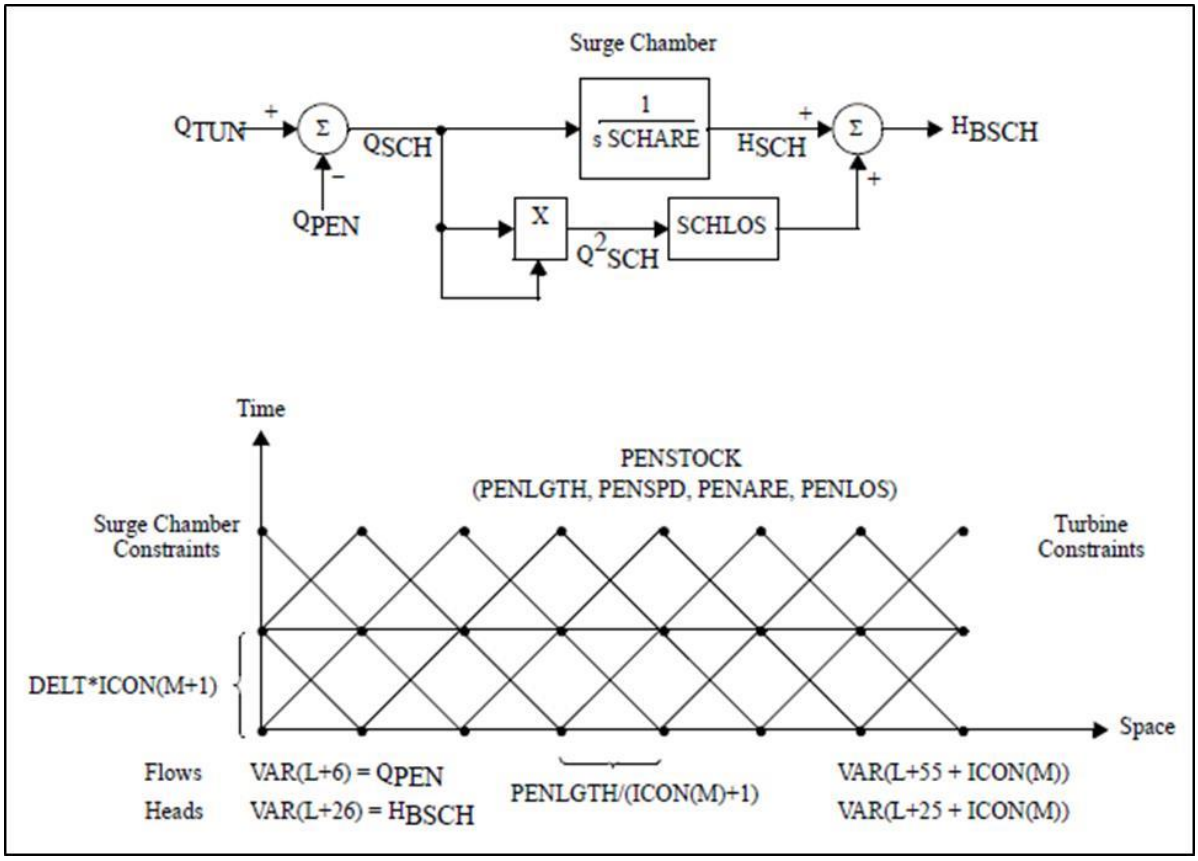


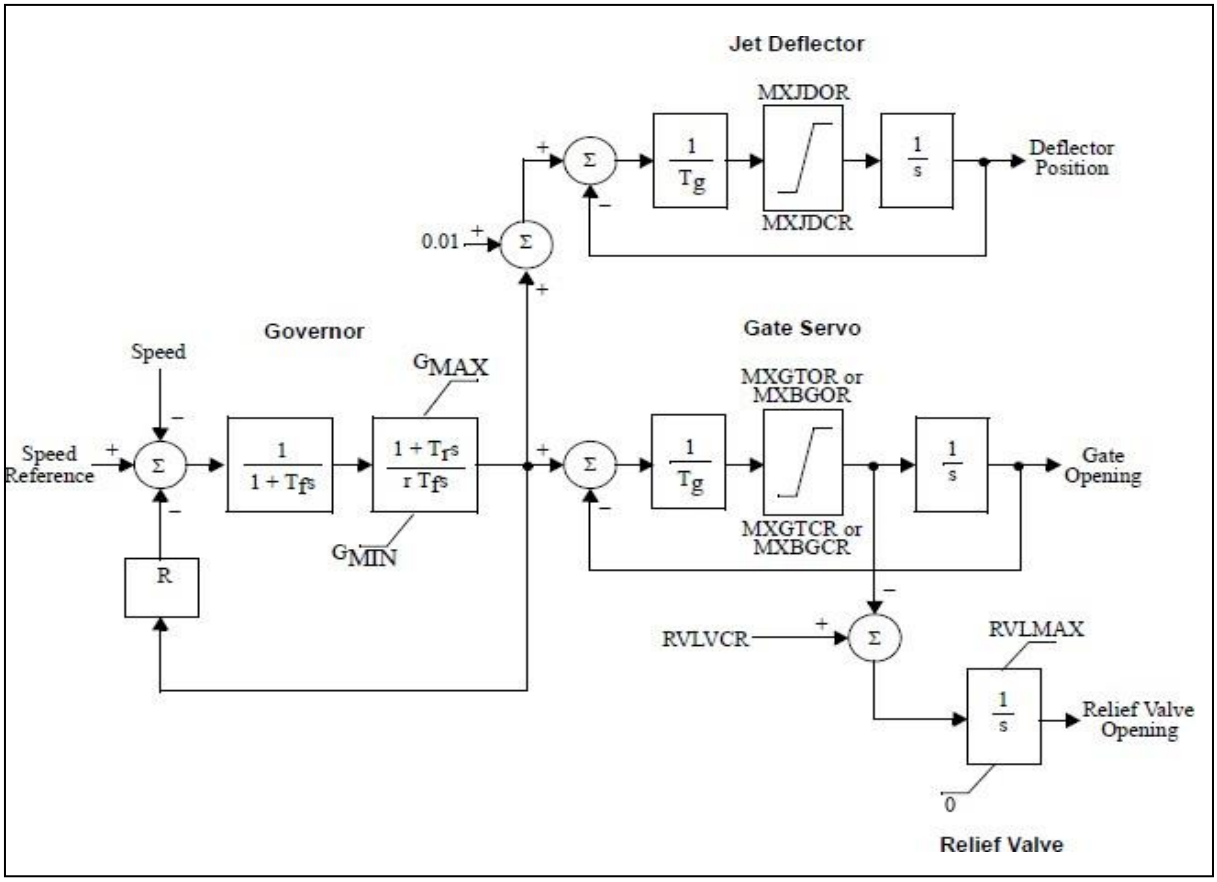
Governor and Hydraulic Actuators

➢ HYGOVT: Hydro Turbine-Governor Traveling Wave Model

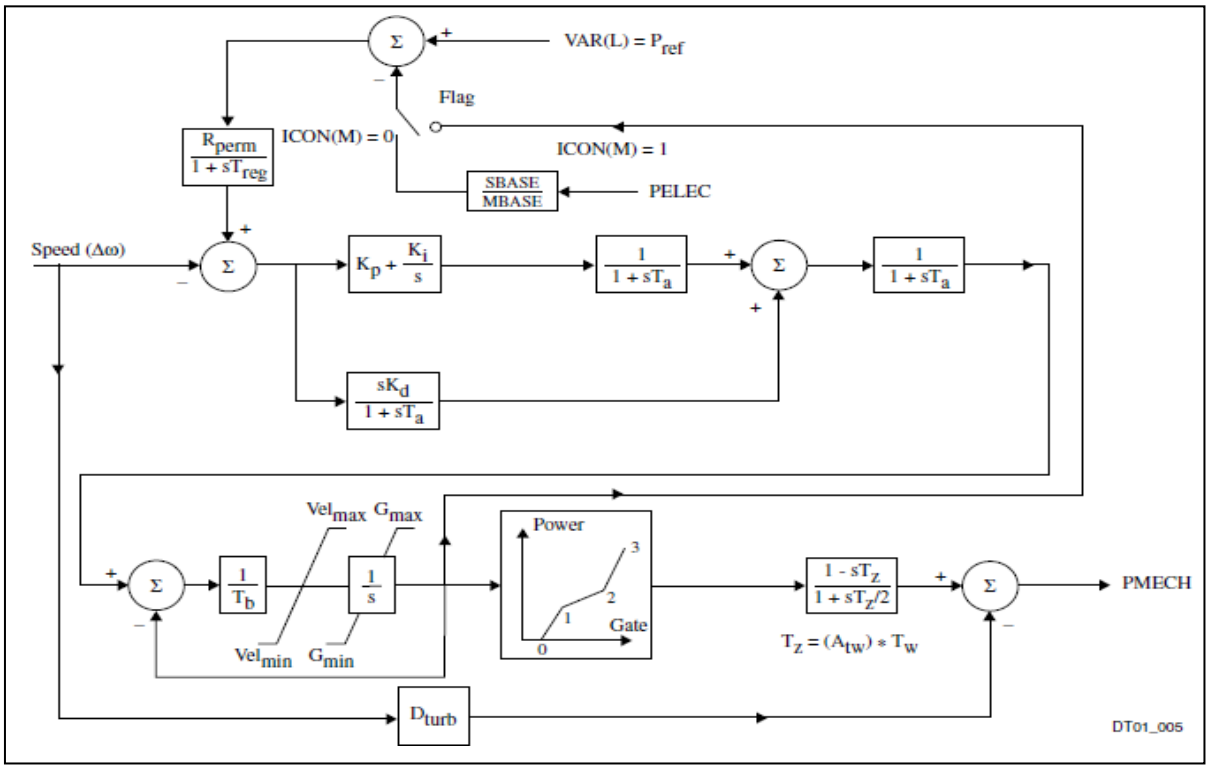




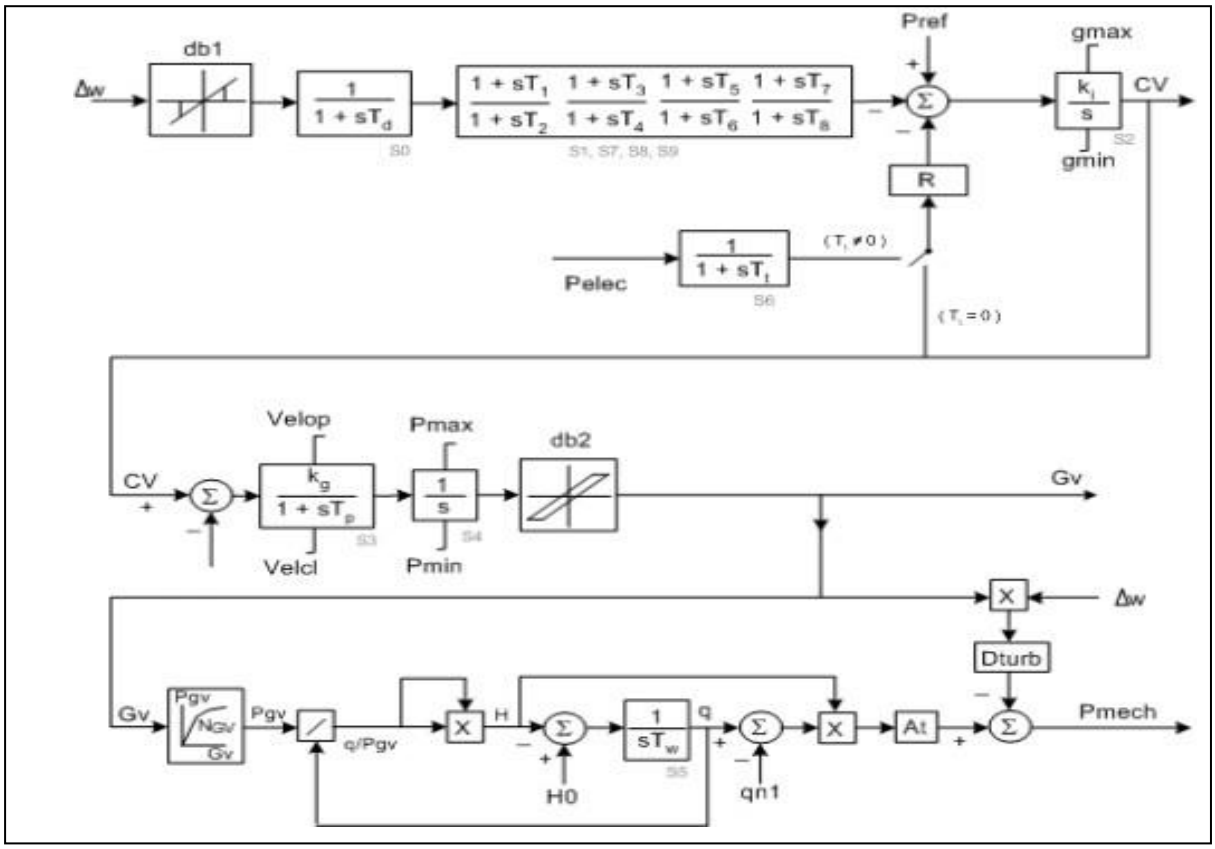

Surge Chamber
QTUN
QSCH
QPEN
1
s SCHARE
HSCH
HBSCH
X
Q2SCH
SCHLOS
Time
PENSTOCK
(PENLGTH, PENSPD, PENARE, PENLOS)
Surge Chamber Constraints
Turbine Constraints
DELT*ICON(M+1)
Space
Flows
Heads
VAR(L+6) = QPEN
VAR(L+26) = HBSCH
PENLGTH/(ICON(M)+1)
VAR(L+55 + ICON(M))
VAR(L+25 + ICON(M))


Jet Deflector
MXJDOR
MXJDCR
Deflector Position
0.01
Governor
Gate Servo
Speed
Speed Reference
GMAX
GMIN
R
MXGTOR or MXBGOR
MXGTCR or MXBGCR
Gate Opening
RVLVCR
RVLMAX
Relief Valve Opening
Relief Valve

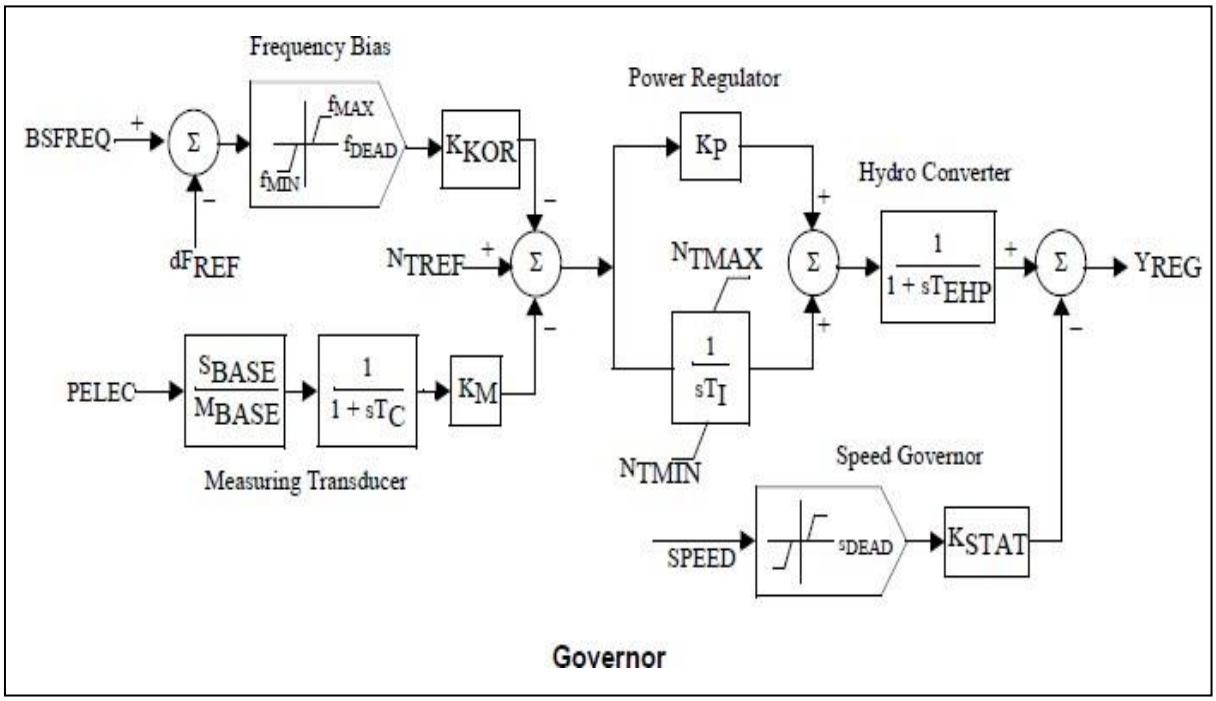
➢ PIDGOV: Hydro Turbine-Governor

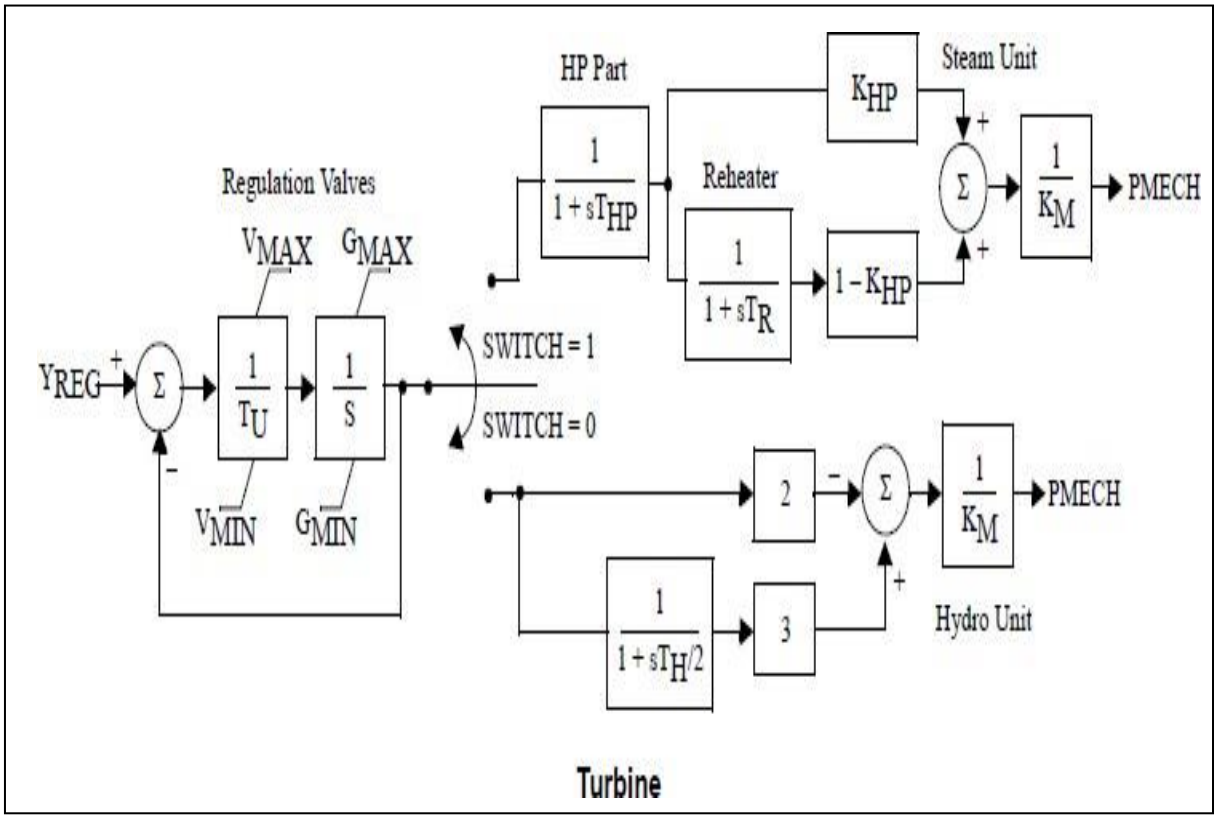


➢ HYGOVR1: Fourth order lead-lag hydro-turbine

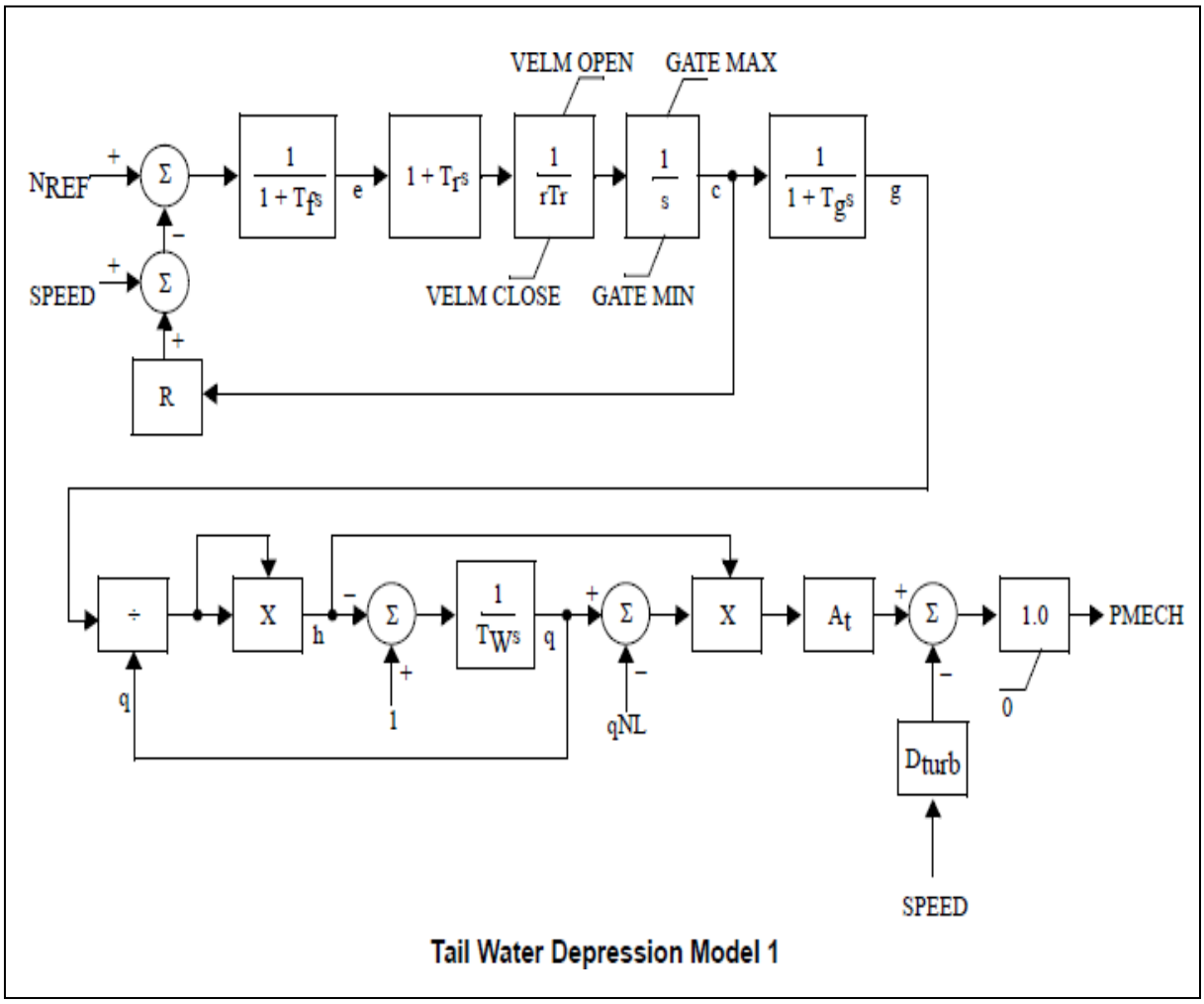


➢ TURCZT: Czech Hydro and Steam Governor

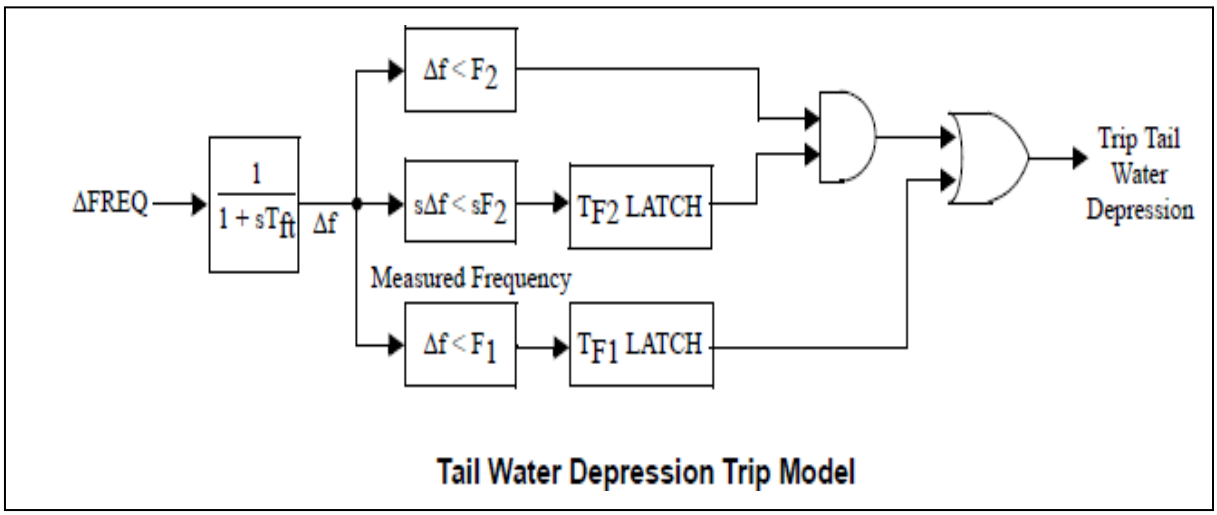




➢ TWDM1T: Tail Water Depression Hydro Governor Model 1

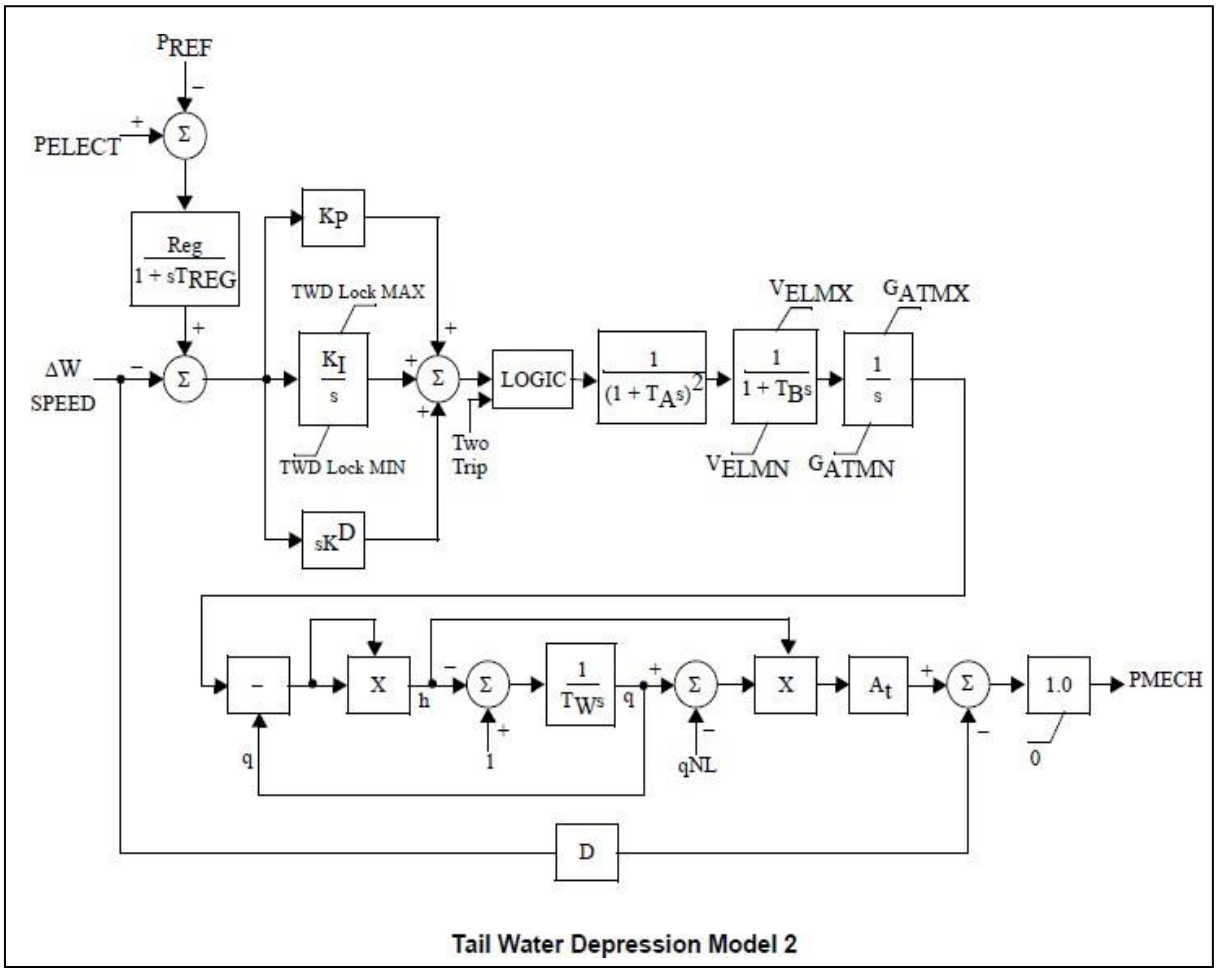


Tail Water Depression Model 1

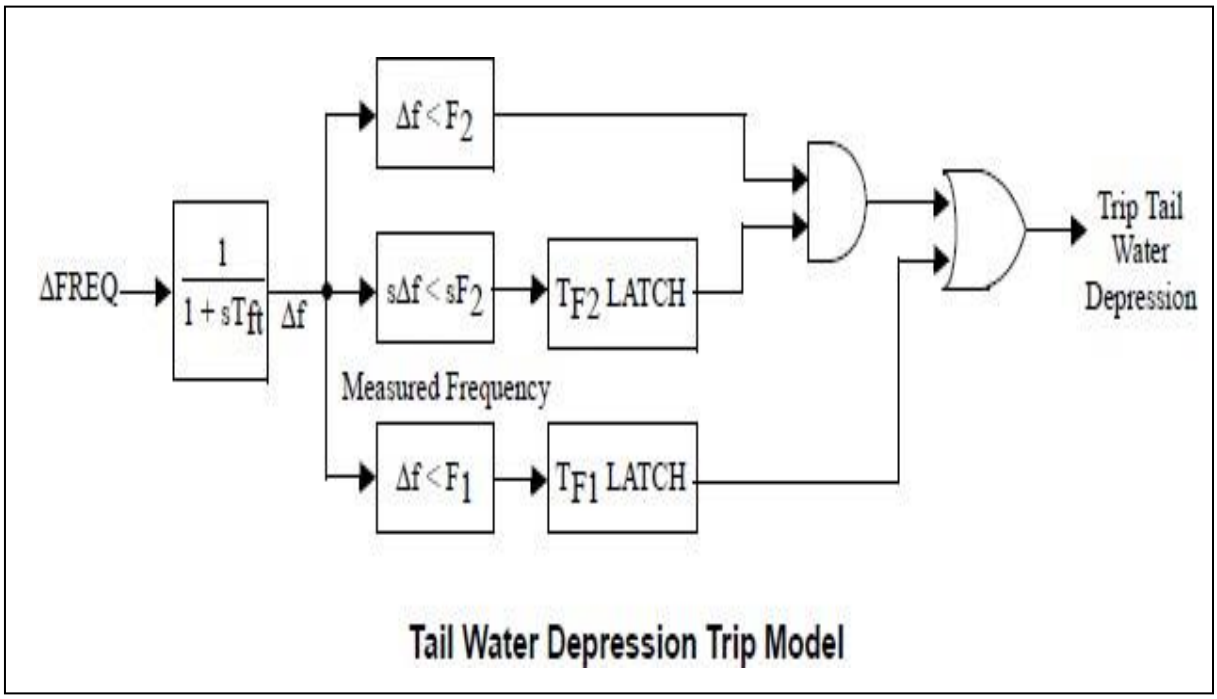


Tail Water Depression Trip Model

➢ TWDM2T: Tail Water Depression Hydro Governor Model 2

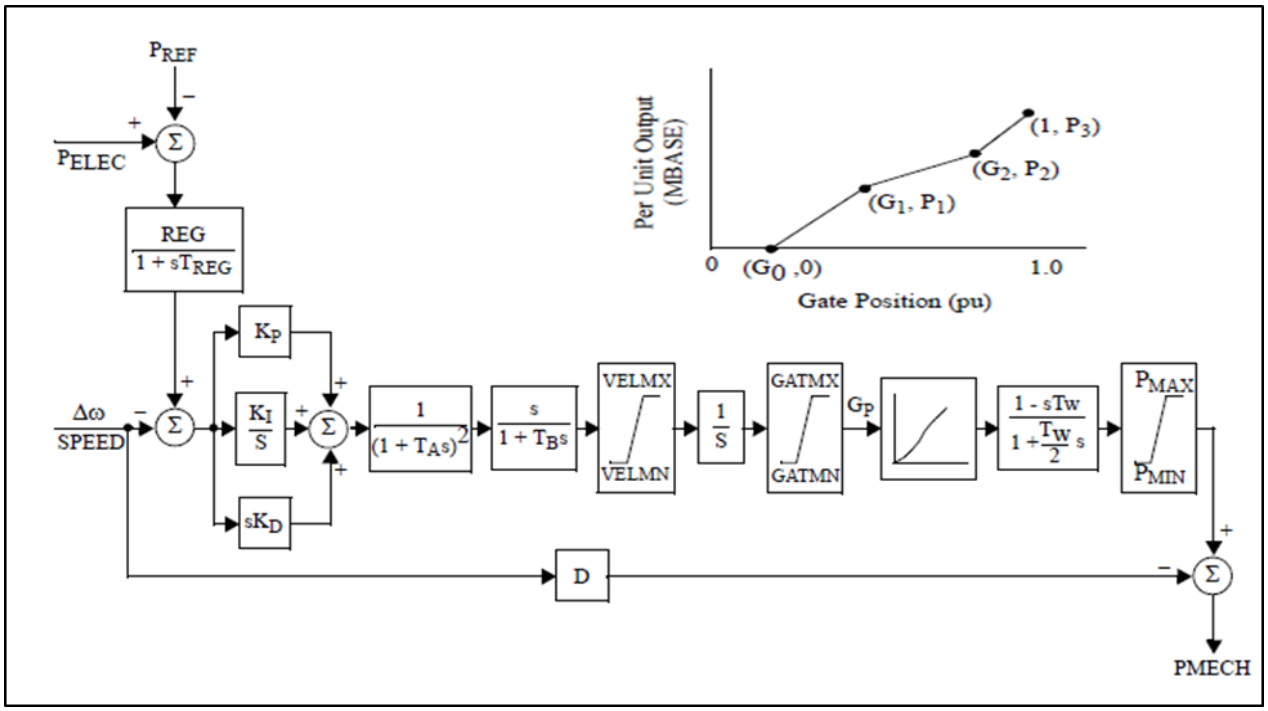


Tail Water Depression Model 2

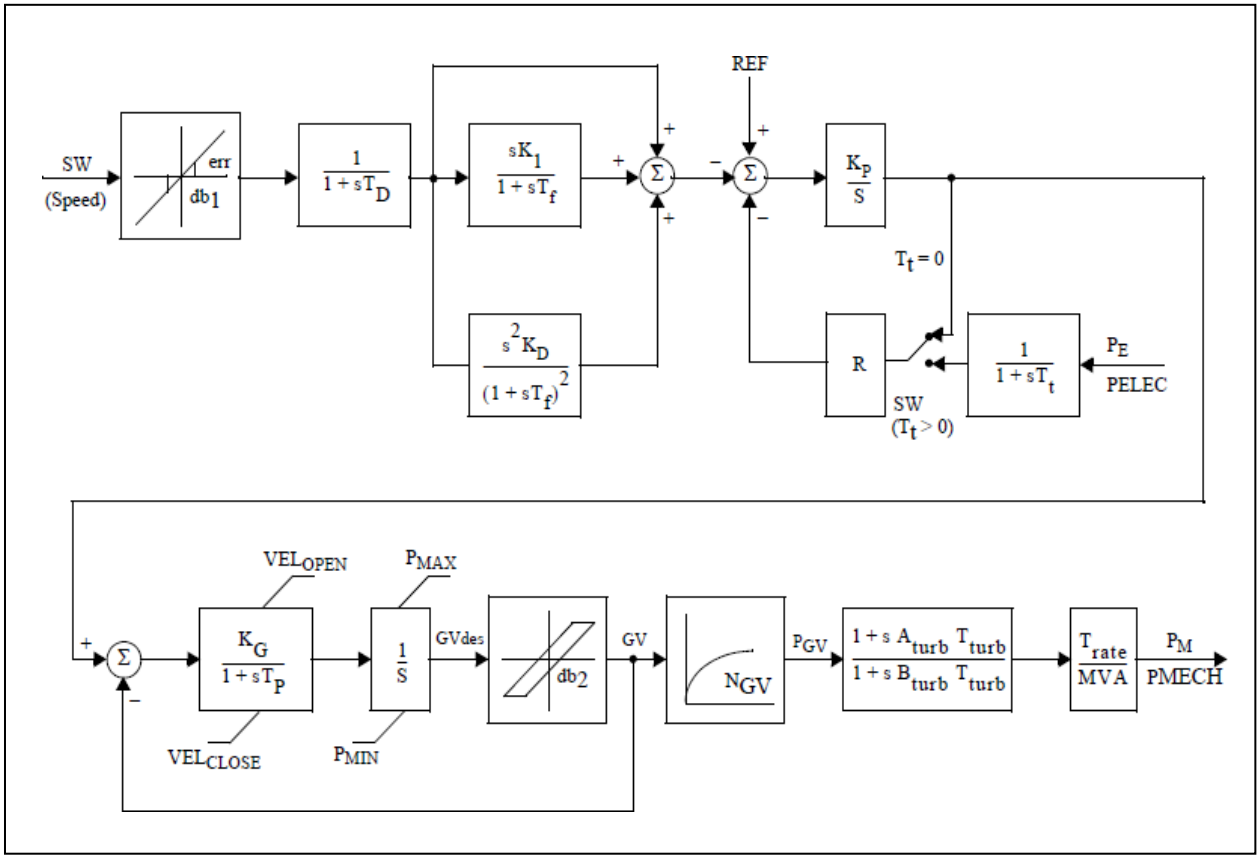


Tail Water Depression Trip Model

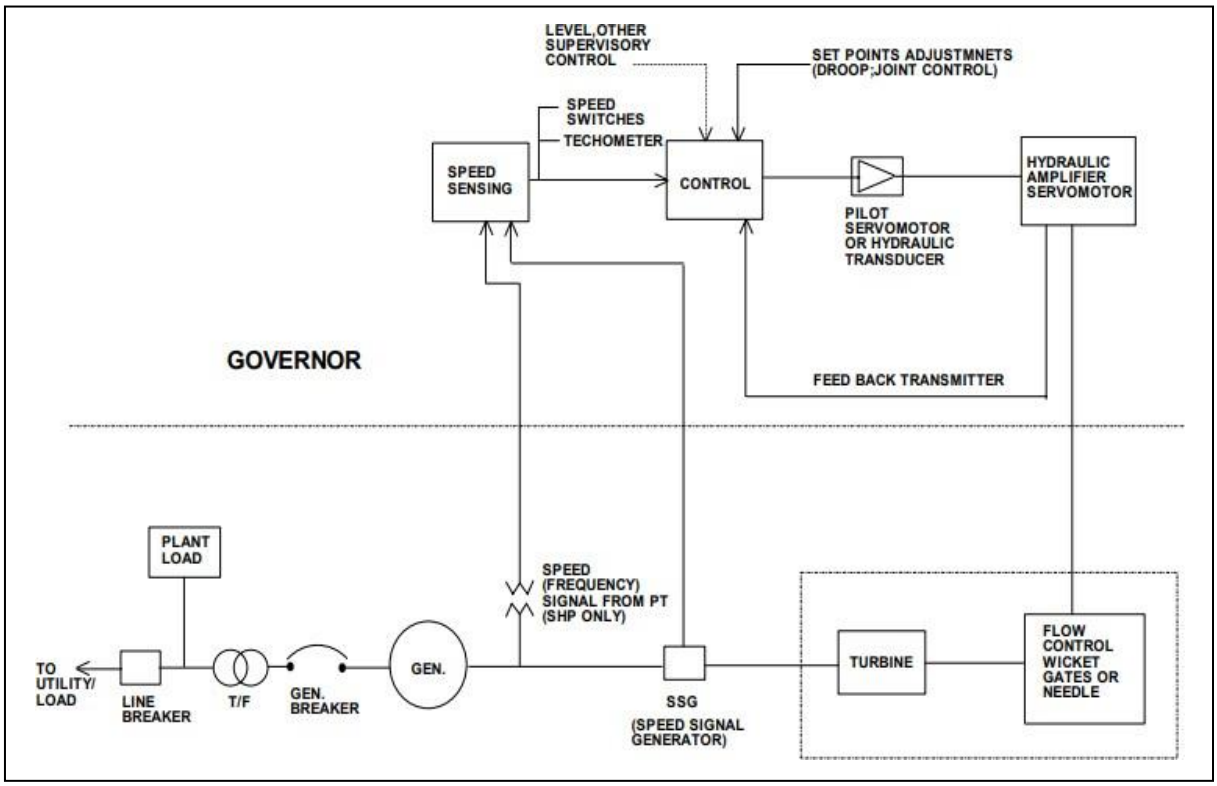
➢ WPIDHY: Woodward PID Hydro Governor



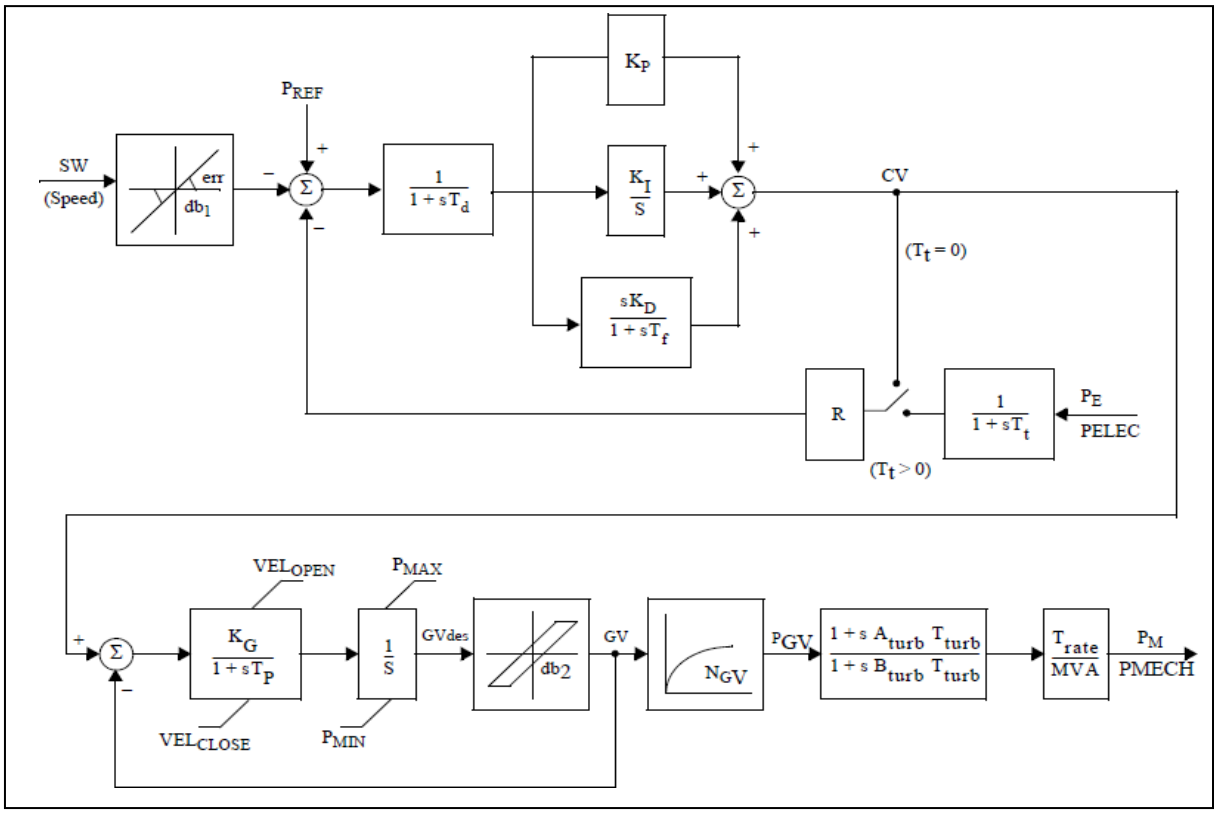
➢ WSHYDD: WECC Double-Derivative Hydro Governor



➢ WSHYGP: WECC GP Hydro Governor Plus Turbine

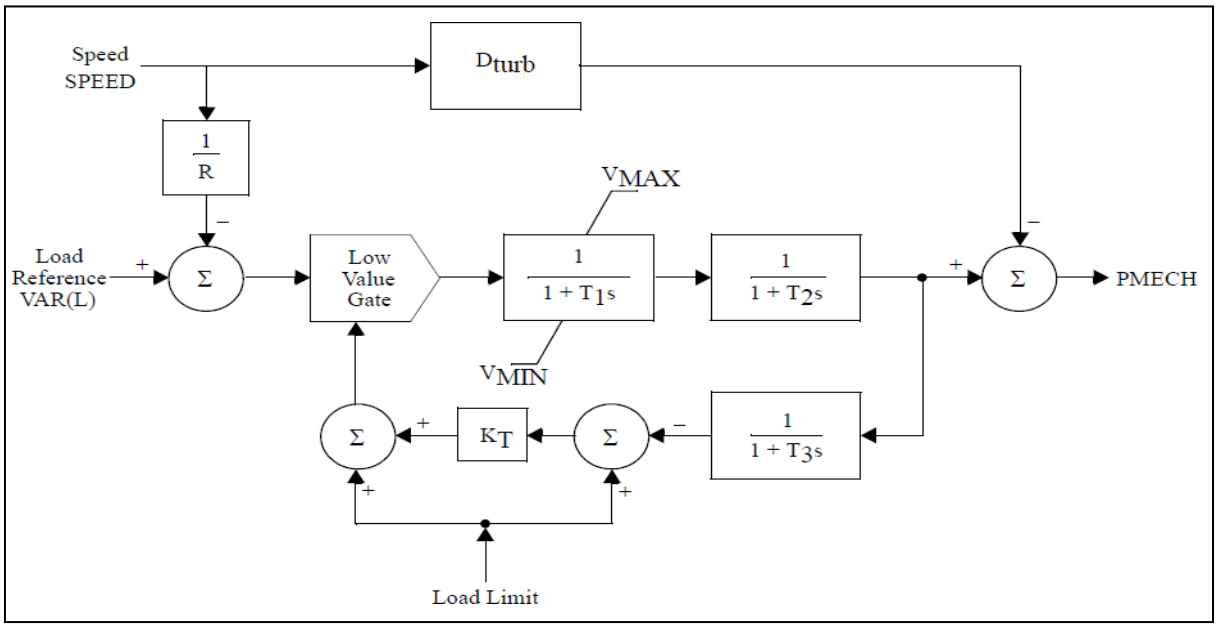


➢ Governing system - Block Diagram (Typical) as per IEEE std. -75

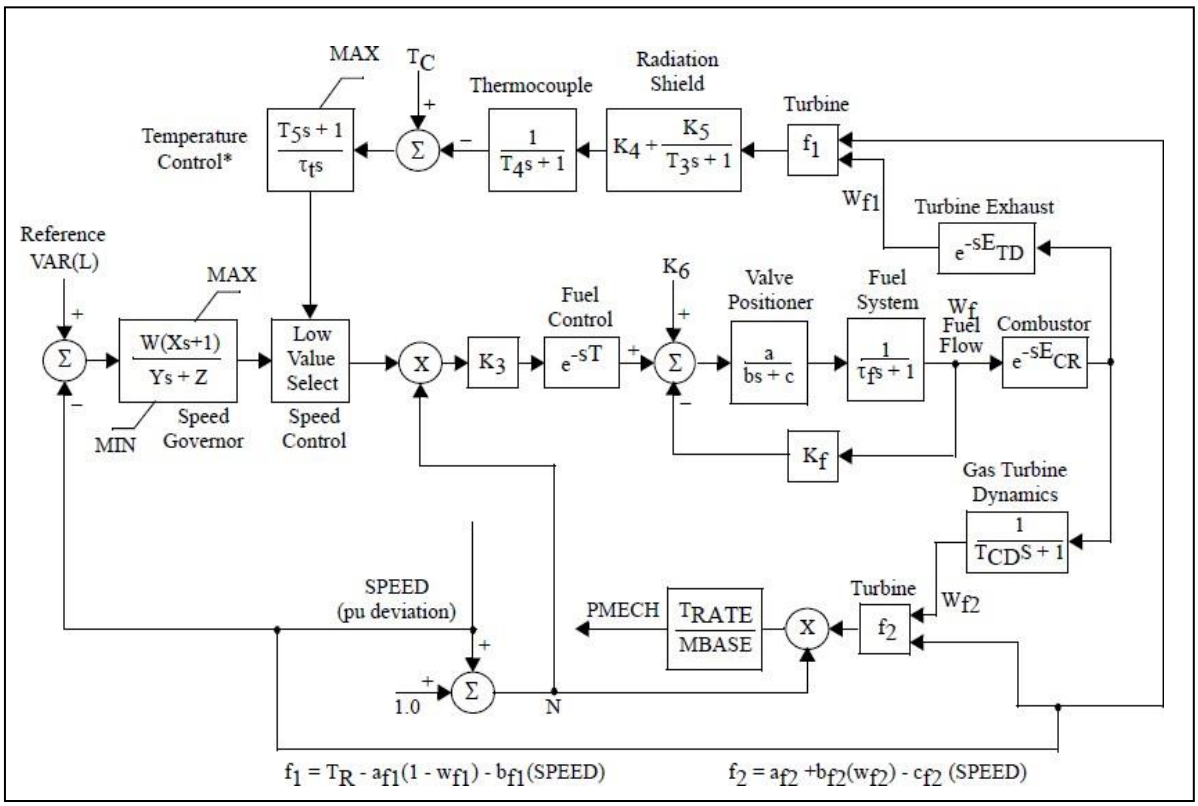


7. Commonly Used Gas Turbine Generic Models Block Diagrams:

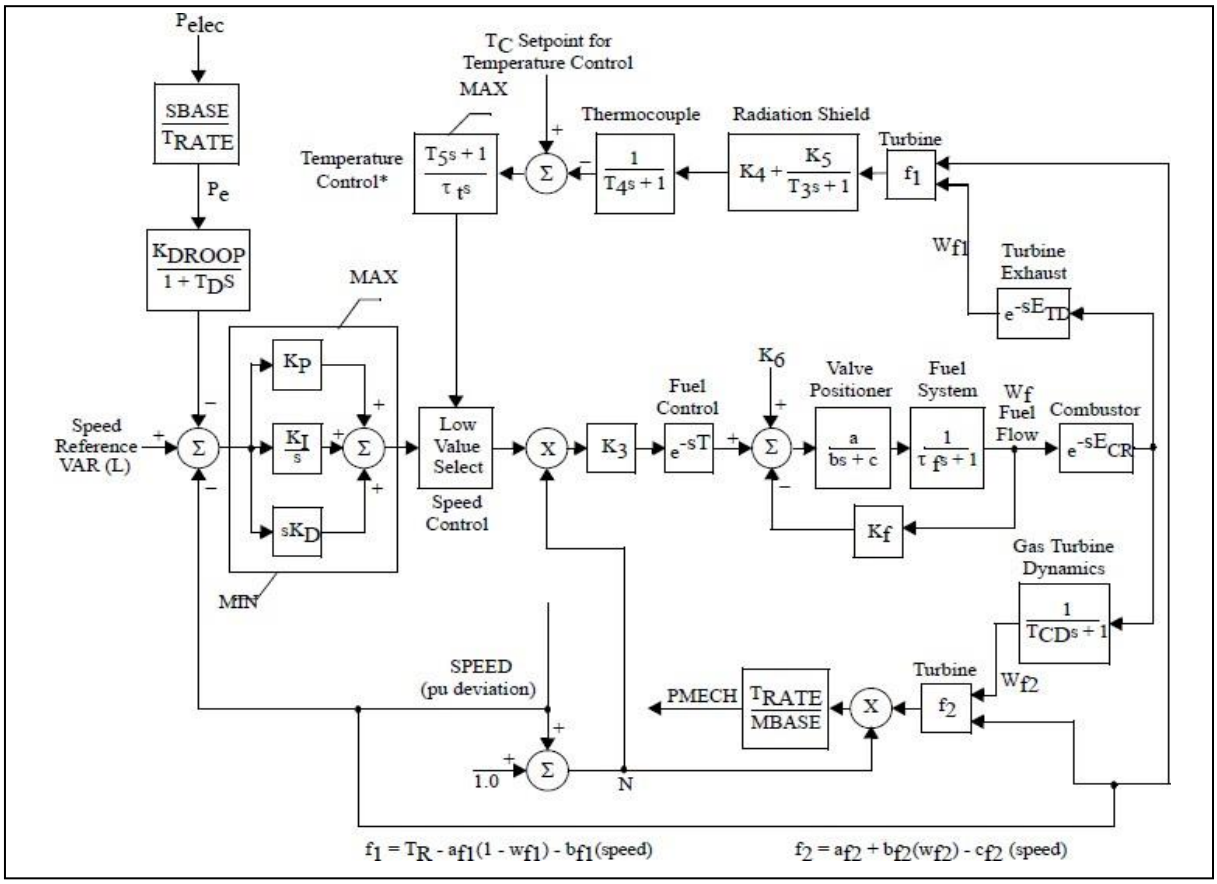
➢ GAST: Gas Turbine-Governor



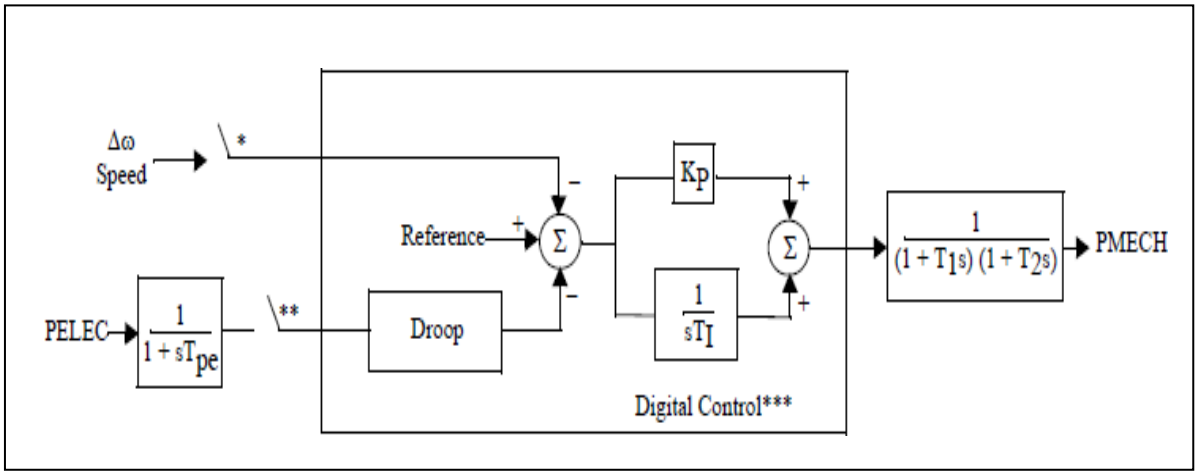
➢ GAST2A: Hydro Turbine-Governor



➢ GASTWD: Woodward Gas Turbine-Governor Model



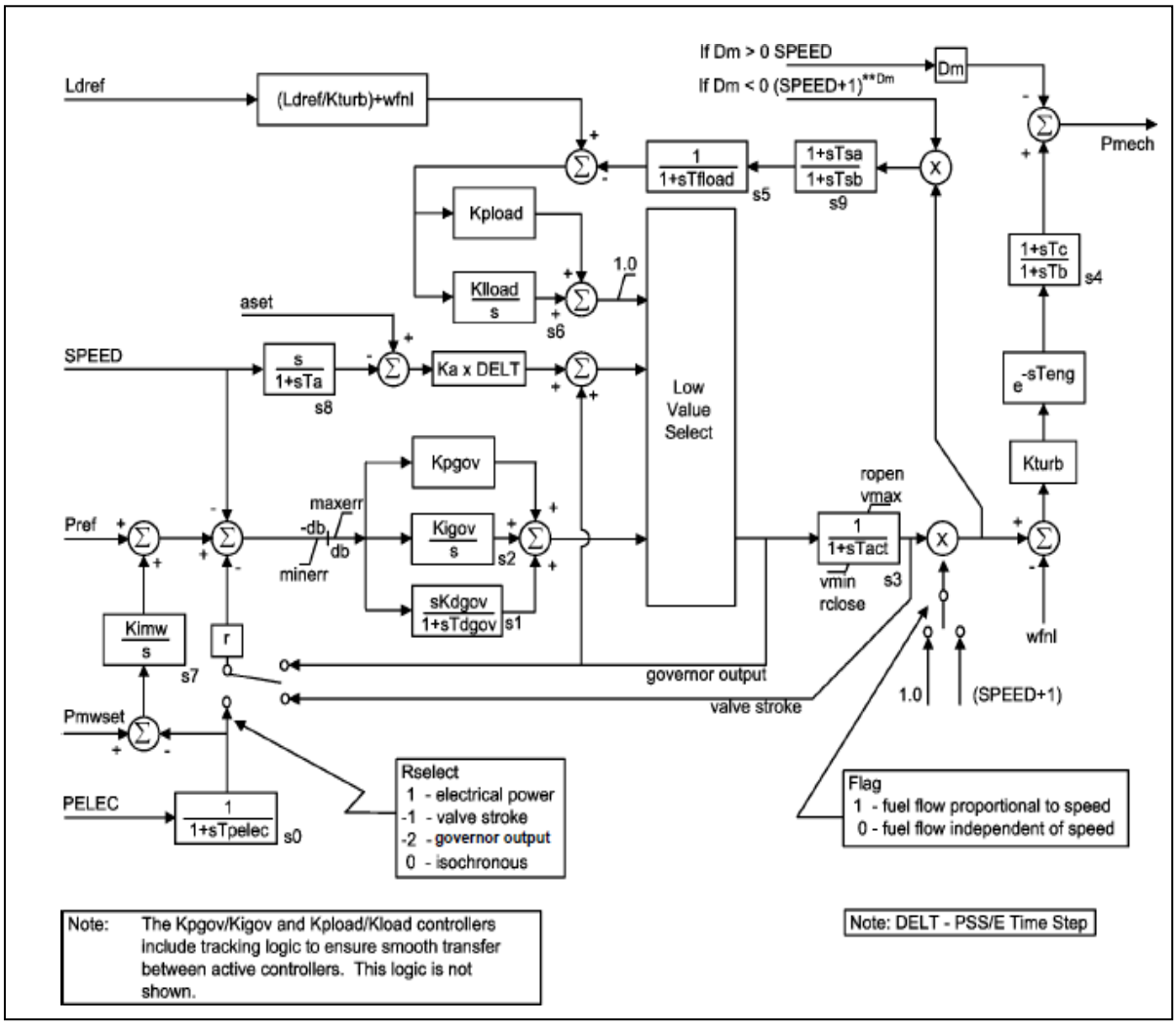
➢ WESGOV: Westinghouse Digital Governor for Gas Turbine



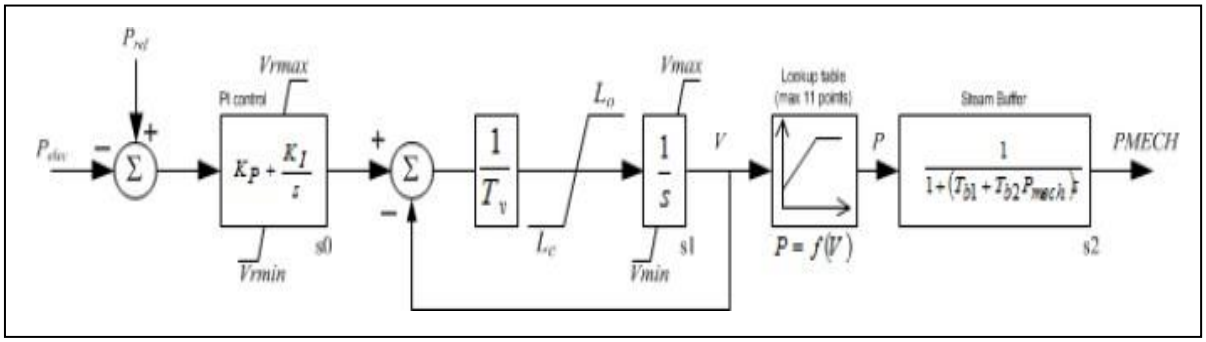
**Sample hold with sample period defined by ΔTC. **Sample hold with sample period defined by ΔTP.*

****Maximum change is limited to ALIM between sampling times.*

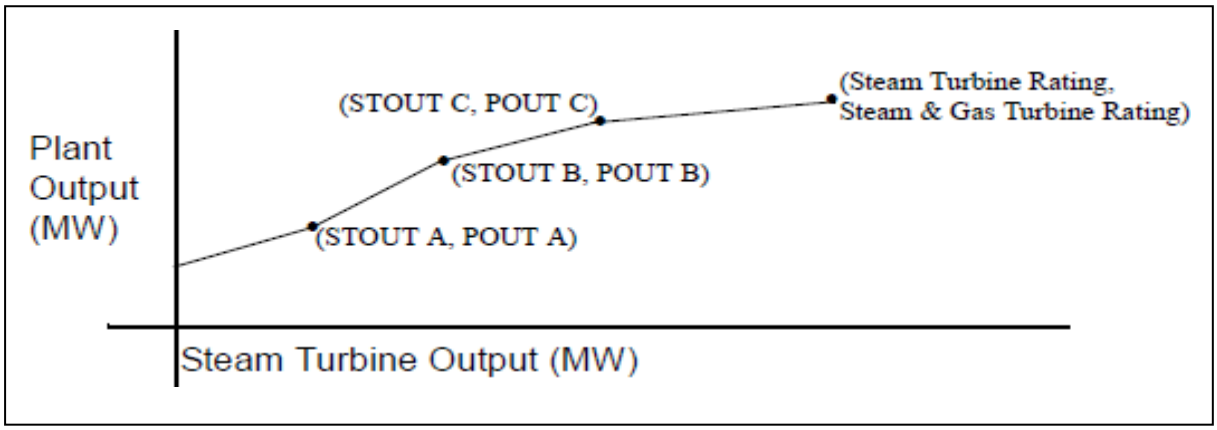
➢ GGOV1: GE General Governor/Turbine Model



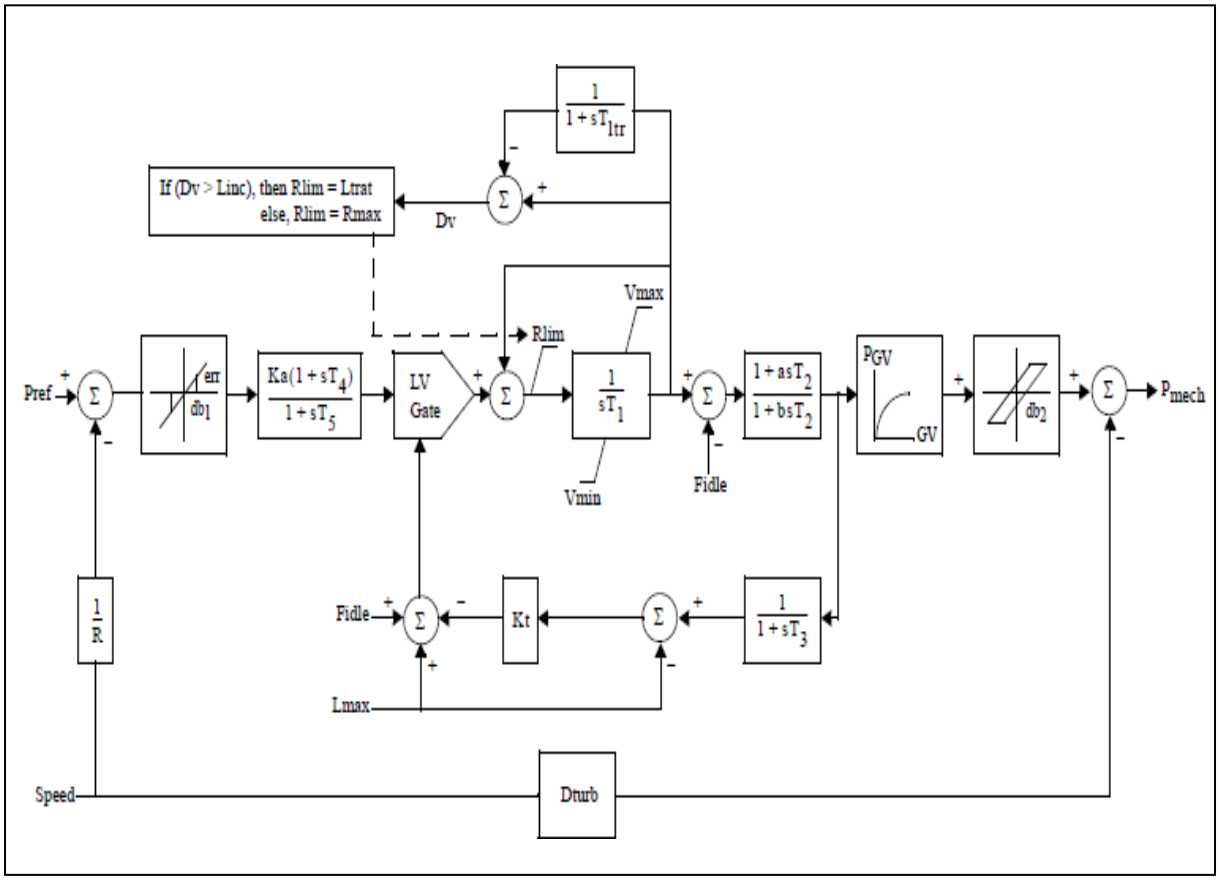
➢ PWTBD1: Pratt & Whitney Turboden Turbine-Governor Model



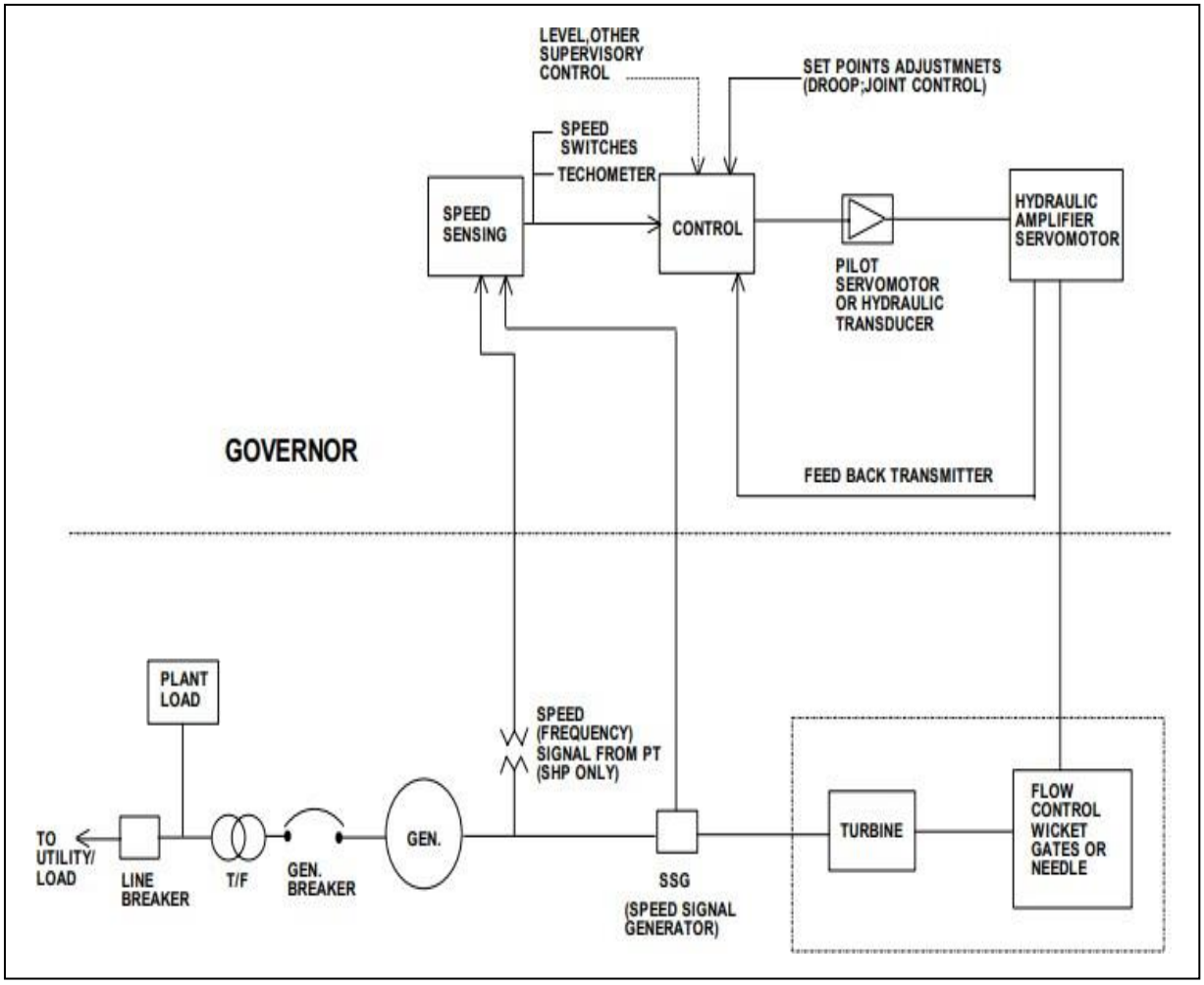
➢ URCSCT: Combined Cycle on Single Shaft



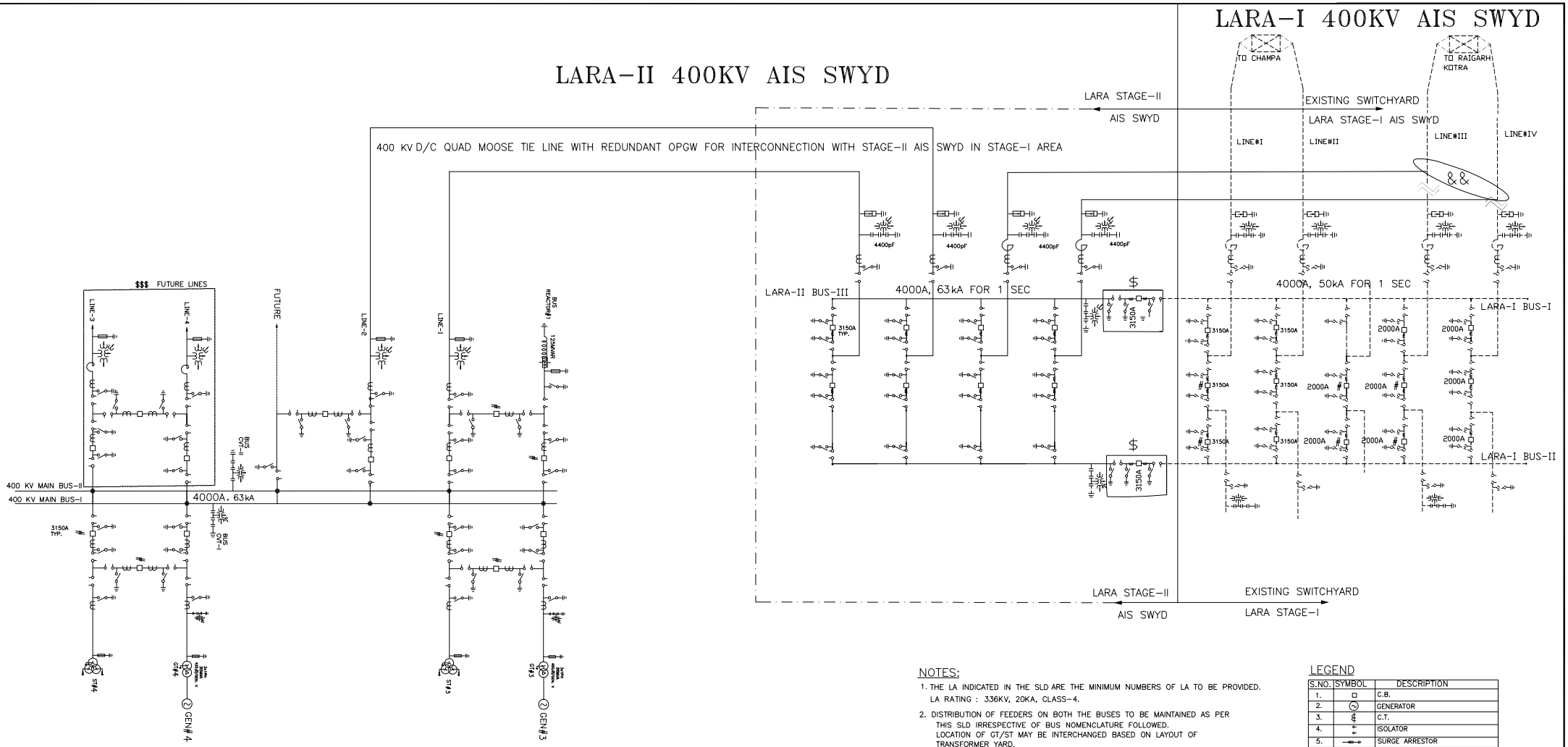
➢ URGS3T: WECC Gas Turbine Model



➢ Governing system - Block Diagram (Typical) as per IEEE std. -75



LARA-II 400KV AIS SWYD



LARA-II 400KV AIS SWYD

NOTES:

1. THE LA INDICATED IN THE SLD ARE THE MINIMUM NUMBERS OF LA TO BE PROVIDED. LA RATING : 336KV, 20KA, CLASS-4.
2. DISTRIBUTION OF FEEDERS ON BOTH THE BUSES TO BE MAINTAINED AS PER THIS SLD IRRESPECTIVE OF BUS NOMENCLATURE FOLLOWED. LOCATION OF GT/ST MAY BE INTERCHANGED BASED ON LAYOUT OF TRANSFORMER YARD.
3. SEPARATE OPGW SHALL BE PROVIDED FOR EACH CIRCUIT OF TIE LINE AND EACH OPGW SHALL HAVE MINIMUM 24 CORES. ONE OPGW SHALL BE THROUGH THE TRANSMISSION TOWER AND THE OTHER ONE SHALL UNDER GROUNDED.

$ MAIN BUS I & II OF LARA I IS EXTENDED ABOVE THE SPACE INDICATED FOR BUS SECTIONALISATION. NECESSARY MODIFICATION FOR INSTALLATION OF BUS SECTION IS IN BIDDER'S SCOPE.

&& BIDDERS SCOPE OF WORK SHALL INCLUDE INTERCONNECTION OF O/G LINE BAYS IN LARA-II AIS SWITCHYARD WITH THE EXISTING TOWER OF LARA-I TO RAIGARH (KOTRA) LINE. MODIFICATIONS REQUIRED FOR THIS PURPOSE ARE ALSO IN BIDDERS SCOPE.

$$$ ONE COMPLETE 400KV AIS DIA (LINE-III-TIE-LINE-IV) ALONG WITH ASSOCIATED AIS EQUIPMENT CABLE, CABLING, CONTROL & PROTECTION AND METERING, CIVIL WORKS ETC, COMPLETE IN ALL RESPECT AS PER SLD AND TECHNICAL SPECIFICATION SHALL BE QUOTED SEPARATELY IN PRICE SCHEDULE

LEGEND

S.NO.	SYMBOL	DESCRIPTION
1.		C.B.
2.		GENERATOR
3.		C.T.
4.		ISOLATOR
5.		SURGE ARRESTOR
6.		C.V.T.
7.		EARTHING SWITCH
8.		INTERCONNECTING TRANSFORMER
9.		WAVE TRAP.
10.		BUSHING CT
11.	---------	FUTURE
12.	#	AIS BREAKER HAVING CONTROLLED SWITCHING FACILITY

FOR TENDER PURPOSE ONLY

NTPC Limited

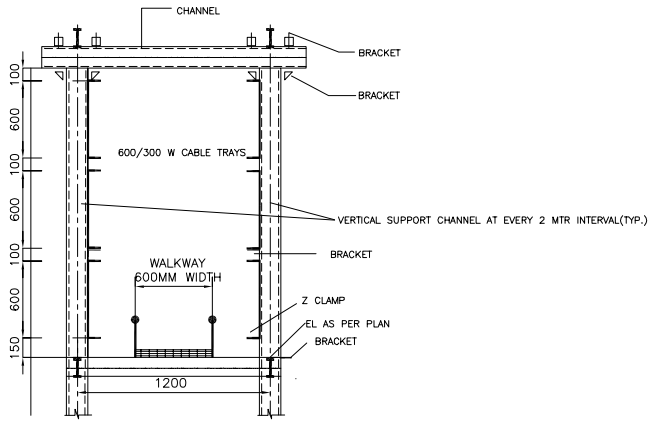
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	APPD	DATE
0	RELEASED FOR FR PURPOSE ONLY	SHADEEP	ST	VRB	R.S.JHA	01.08.09

PROJECT: LARA SUPER THERMAL POWER PROJECT STAGE-II (2x 800MW)

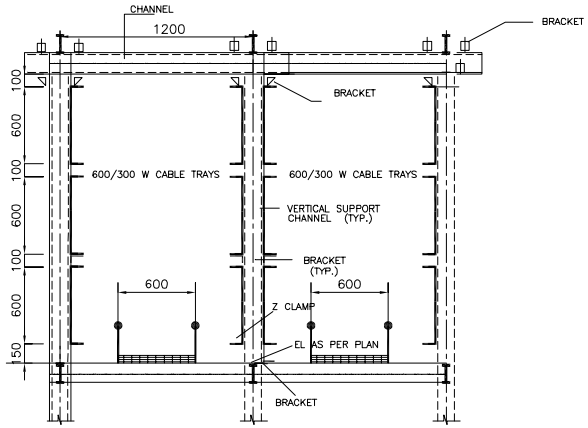
TITLE: SINGLE LINE DIAGRAM 400KV SWITCHYARD

SIZE	SCALE	DRAWING NO.	REV. NO.
A3	NA	9587-999-POE-J-002	II

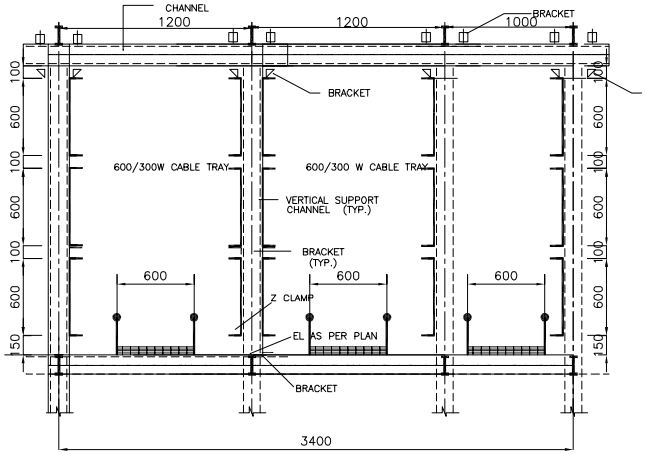
LARA-400KV-SWYD-SLD.DWG



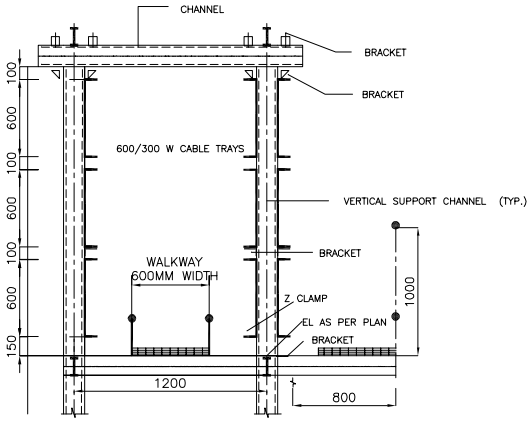
TYPICAL SECTION OF CABLE TRAY ARRANGEMENT (6 NOS).
CABLE TRAYS & ITS SUPPORTING ARRANGEMENT TO BE PROVIDED BY CONTRACTOR
(ALL SUPPORT STRUCTURE & CABLE TRAYS ARE IN CONTRACTOR SCOPE).



TYPICAL SECTION OF CABLE TRAY ARRANGEMENT (UPTO 12 NOS)
CABLE TRAYS & ITS SUPPORTING ARRANGEMENT TO BE PROVIDED BY CONTRACTOR
(ALL SUPPORT STRUCTURE & CABLE TRAYS ARE IN CONTRACTOR SCOPE).



TYPICAL SECTION OF CABLE TRAY ARRANGEMENT (UPTO 18 NOS)
CABLE TRAYS & ITS SUPPORTING ARRANGEMENT TO BE PROVIDED BY CONTRACTOR
(ALL SUPPORT STRUCTURE & CABLE TRAYS ARE IN CONTRACTOR SCOPE).



TYPICAL SECTION OF CABLE TRAY ARRANGEMENT (UPTO 9 NOS).
CABLE TRAYS & ITS SUPPORTING ARRANGEMENT TO BE PROVIDED BY CONTRACTOR
(ALL SUPPORT STRUCTURE & CABLE TRAYS ARE IN CONTRACTOR SCOPE).

NTPC Limited.
(A Government of India Enterprise)
ENGINEERING DIVISION

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	CLEARED BY	APPD	DATE
0	RELEASED FOR CONSTRUCTION	MV			M E C C&I –		23-01-2015

PROJECT: LARATHERMAL POWER PROJECT
STAGE– II (2X800MW)

TITLE: TYPICAL SECTION OF CABLE TRAY ARRANGEMENT IN TRESTLE

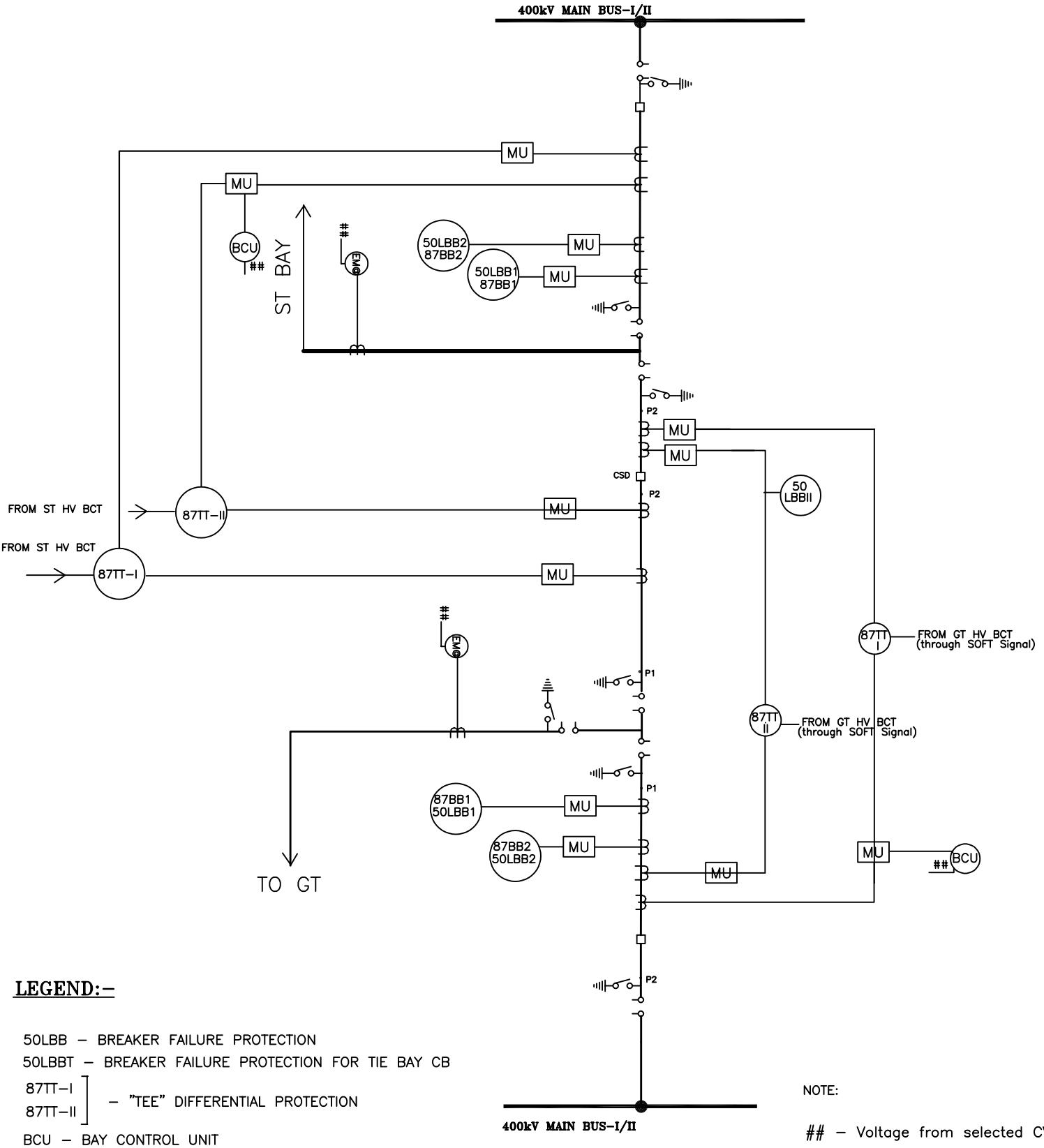
SIZE	SCALE	DRG. NO.	REV. NO.
		9587-999-POE-J-004	1

FROM ST HV BCT

NOTE–ST RELAY PANEL WILL BE PLACED ALONG SIDE GRP

BUS BAR arrangemnet shown is indicative only.For actual arrangement please refer key tender SLD.

MU can be optimised however minimum 2 no of Mus for each CT to be provided



LEGEND:–

50LBB – BREAKER FAILURE PROTECTION

50LBBT – BREAKER FAILURE PROTECTION FOR TIE BAY CB

87TT–I, 87TT–II – "TEE" DIFFERENTIAL PROTECTION

BCU – BAY CONTROL UNIT

EM – ABT COMPLIANT ENERGY METER

79 – MAIN CB AUTORECLOSER RELAY

79T – TIE CB AUTORECLOSER RELAY

EM – ENERGY METER ABT

EM–MAIN – ENERGY METER MAIN ABT TYPE

EM–CH – ENERGY METER CHECK ABT TYPE

MU – MERGING UNIT

NOTE:

– Voltage from selected CVT

* – To be provided by owner

** – Breaker with CSD

FOR TENDER PURPOSE ONLY

NTPC Ltd.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

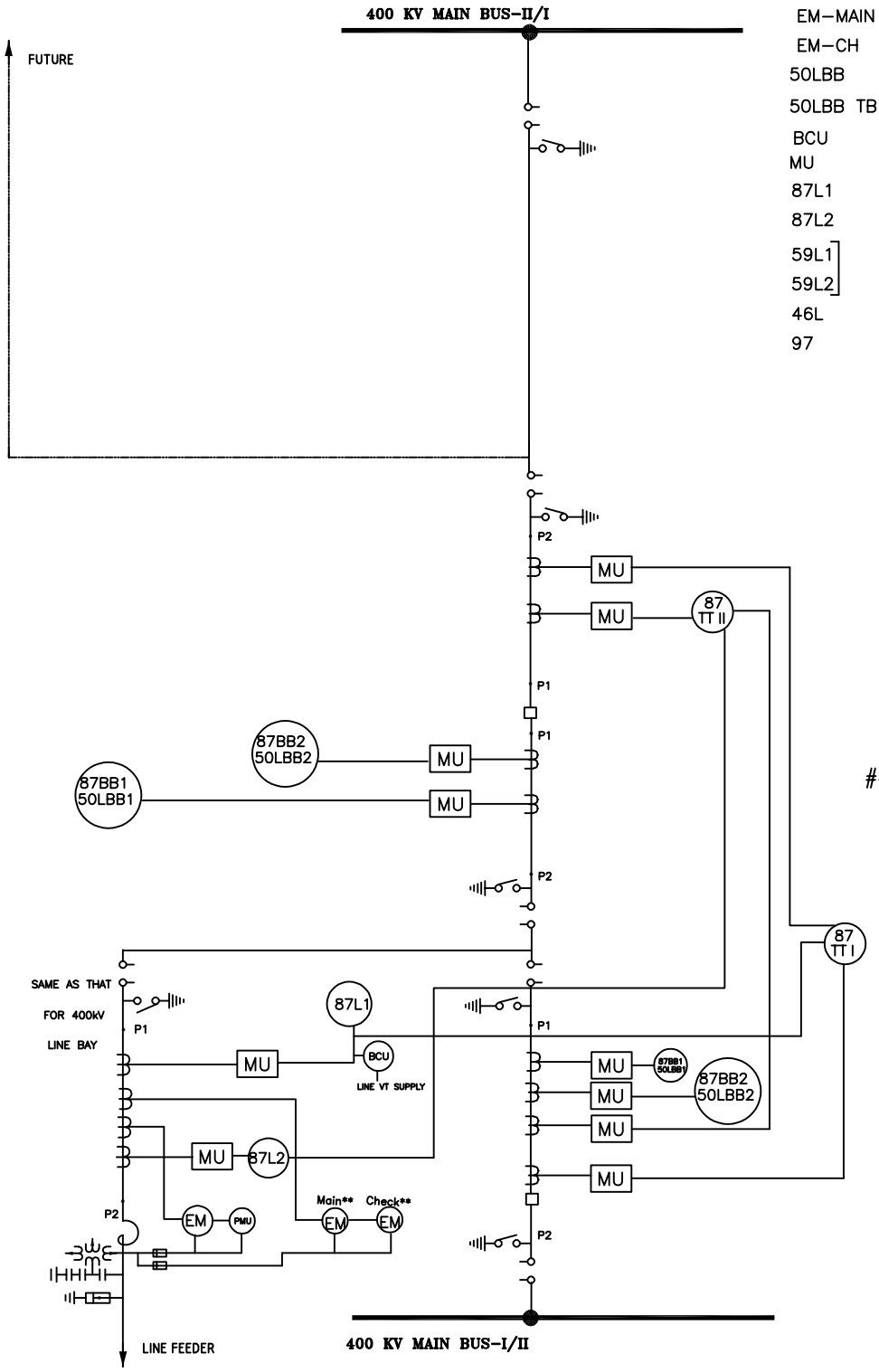
PROJECT: LARA TPP STAGE–II (2X800MW)
400kV SWITCHYARD PACKAGE

TITLE: PROTECTION S.L.D. FOR GT–TIE–ST DIA

REV.NO.	DESCRIPTION	DESIGN	CHKD.	APPD	DATE	SIZE	SCALE	DRG. NO.	REV. NO.
						A4	N.T.S.	9587-999-POE-J-005	1

LEGEND:–

87TT–I 87TT–II	–	"TEE" DIFFERENTIAL PROTECTION
79	–	MAIN CB AUTORECLOSER RELAY
79T	–	TIE CB AUTORECLOSER RELAY
EM	–	ENERGY METER ABT
EM–MAIN	–	ENERGY METER MAIN ABT TYPE
EM–CH	–	ENERGY METER CHECK ABT TYPE
50LBB		BREAKER FAILURE PROTECTION
50LBB TB	–	BREAKER FAILURE PROTECTION TIE BAY
BCU	–	BAY CONTROL UNIT
MU	–	MERGING UNIT
87L1	–	LINE MAIN–I Differential PROTECTION
87L2	–	LINE MAIN–II Differential PROTECTION
59L1 59L2	–	LINE OVER VOLTAGE PROTECTION
46L	–	LINE OPEN JUMPER PROTECTION
97	–	VT FUSE FAILURE PROTECTION



NOTE:

** EM Main/check to be provided by owner

– SELECTED BUS CVT

MU can be optimised however minimum 2 no of Mus for each CT to be provided

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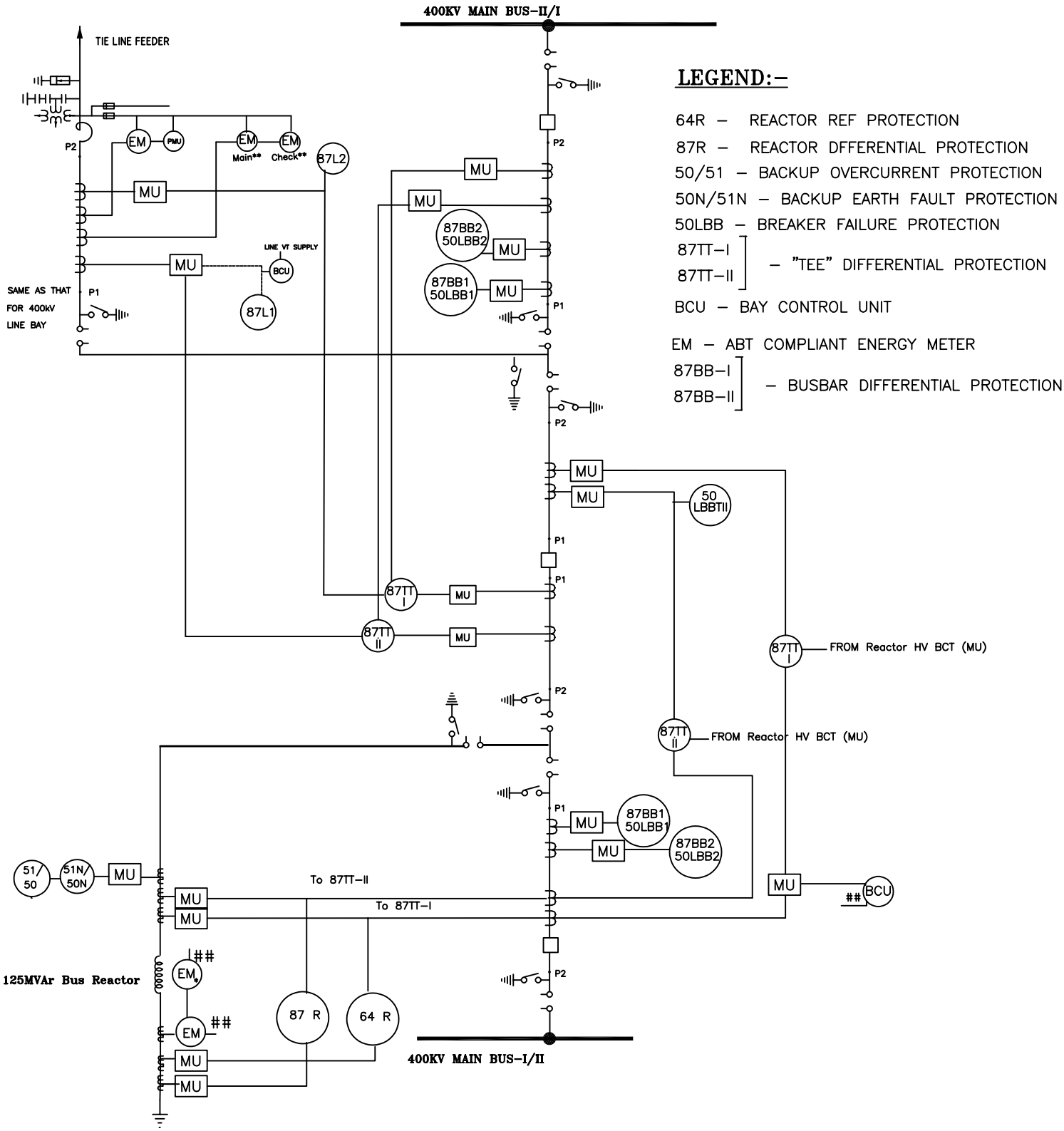
NTPC Ltd.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: LARA STPP STAGE–II (2X8000MW)
400kV SWITCHYARD – PROTECTION SLD

TITLE: PROTECTION S.L.D. FOR LINE–TIE–FUT DIA

REV.NO.	DESCRIPTION	DESIGN	CHKD.	APPD	DATE	SIZE	SCALE	DRG. NO.	REV. NO.
						--	N.T.S.	9587-999-POE-J-008	2



LEGEND:-

64R – REACTOR REF PROTECTION
87R – REACTOR DFFERENTIAL PROTECTION
50/51 – BACKUP OVERCURRENT PROTECTION
50N/51N – BACKUP EARTH FAULT PROTECTION
50LBB – BREAKER FAILURE PROTECTION
87TT-I, 87TT-II – "TEE" DIFFERENTIAL PROTECTION
BCU – BAY CONTROL UNIT
EM – ABT COMPLIANT ENERGY METER
87BB-I, 87BB-II – BUSBAR DIFFERENTIAL PROTECTION

MU can be optimised however minimum 2 no of Mus for each CT to be provided

NOTE:

– Voltage from selected CVT
* – To be provided by owner
** – Breaker with CSD

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NTPC Ltd.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

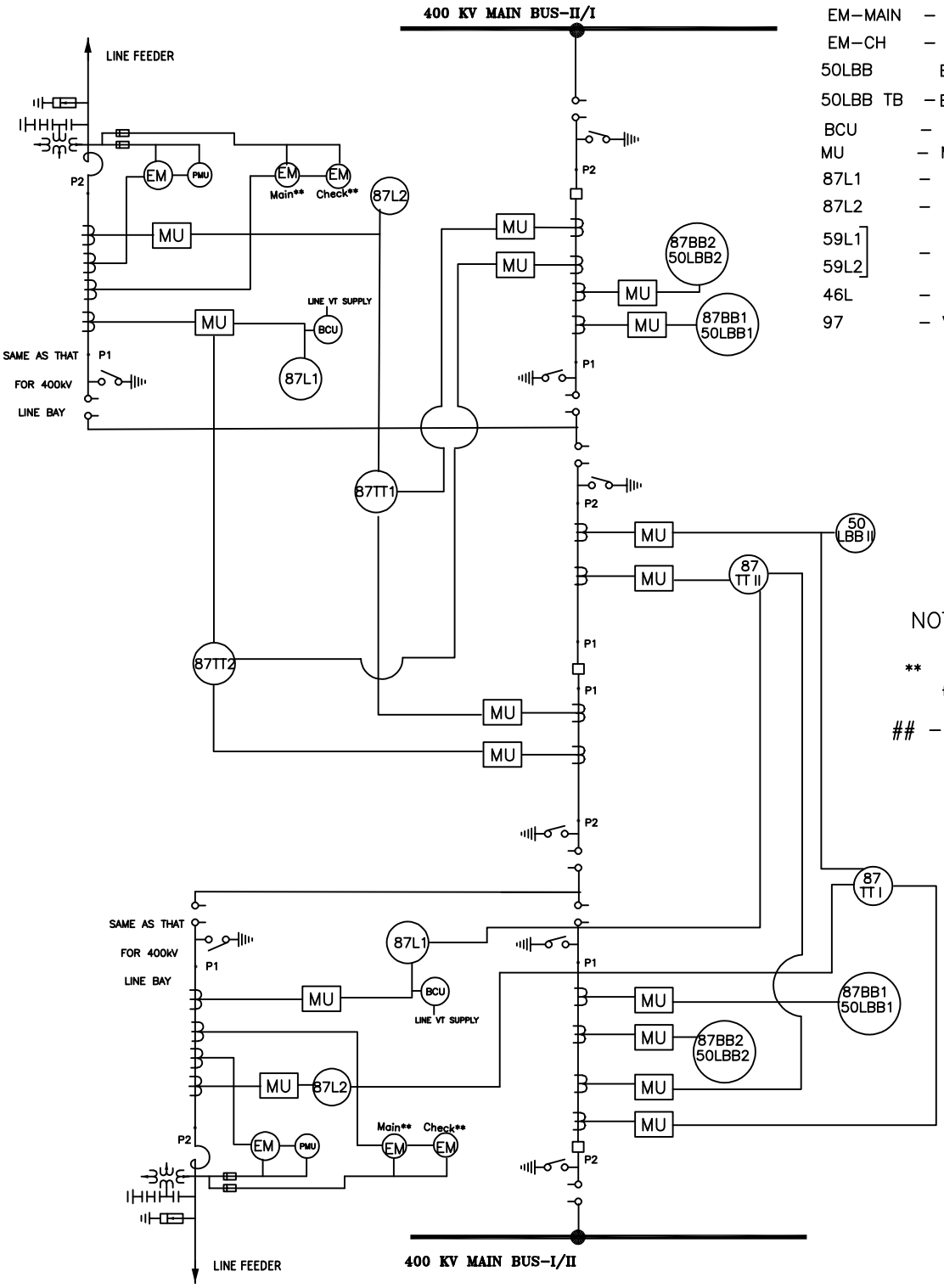
PROJECT: LARA TPP STAGE-II (2X800MW)
400kV SWITCHYARD

TITLE: PROTECTION S.L.D. FOR LINE-TIE-BR DIA

REV.NO.	DESCRIPTION	DESIGN	CHKD.	APPD	DATE	SIZE	SCALE	DRG. NO.	REV. NO.
						--	N.T.S.	9587-999-POE-J-007	2

LEGEND:–

87TT–I 87TT–II	–	"TEE" DIFFERENTIAL PROTECTION
79	–	MAIN CB AUTORECLOSER RELAY
79T	–	TIE CB AUTORECLOSER RELAY
EM	–	ENERGY METER ABT
EM–MAIN	–	ENERGY METER MAIN ABT TYPE
EM–CH	–	ENERGY METER CHECK ABT TYPE
50LBB		BREAKER FAILURE PROTECTION
50LBB TB	–	BREAKER FAILURE PROTECTION TIE BAY
BCU	–	BAY CONTROL UNIT
MU	–	MERGING UNIT
87L1	–	LINE MAIN–I Differential PROTECTION
87L2	–	LINE MAIN–II Differential PROTECTION
59L1 59L2	–	LINE OVER VOLTAGE PROTECTION
46L	–	LINE OPEN JUMPER PROTECTION
97	–	VT FUSE FAILURE PROTECTION



NOTE:

** EM Main/check to be provided by owner

– SELECTED BUS CVT

MU can be optimised however minimum 2 no of Mus for each CT to be provided

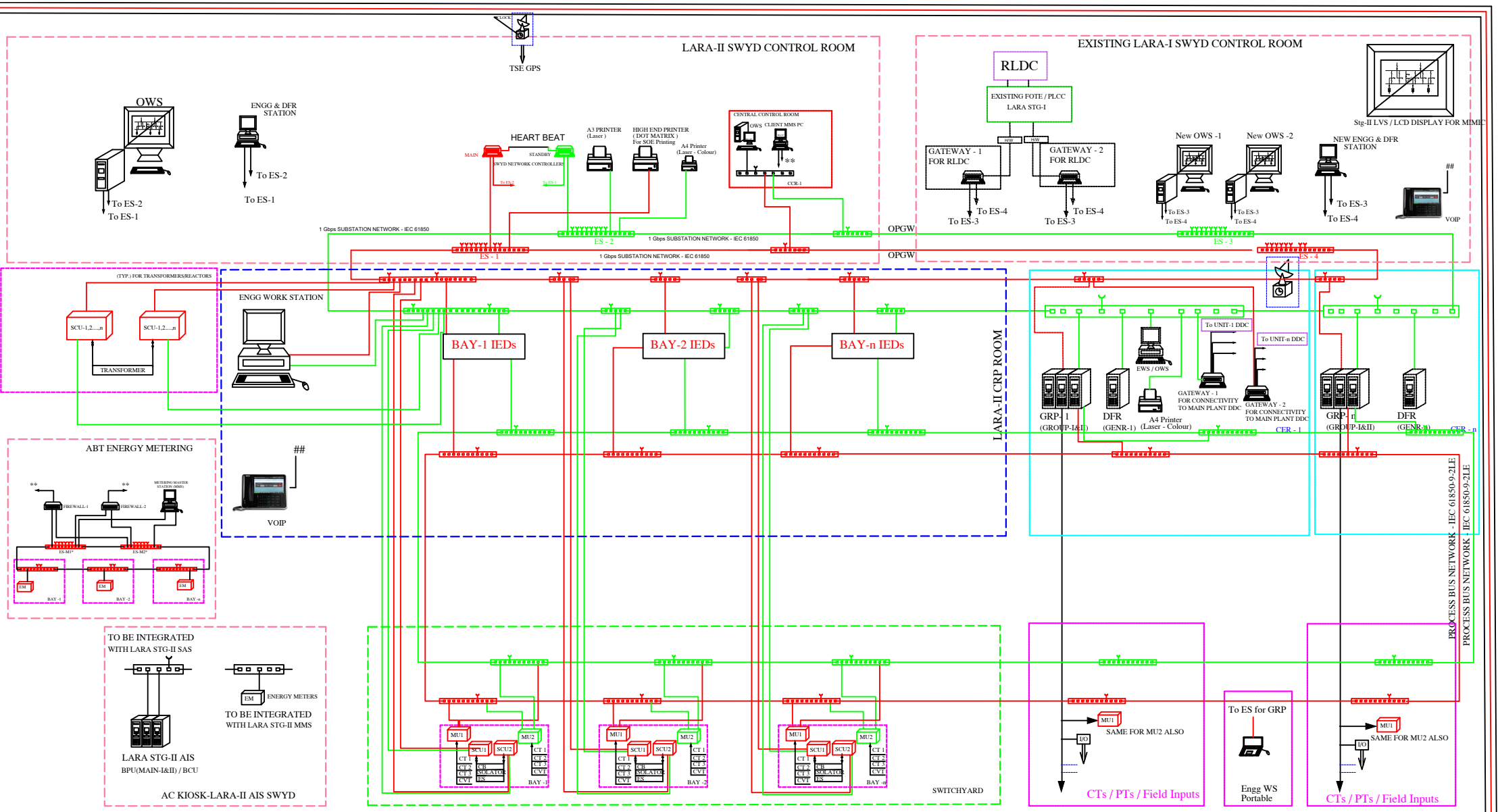
FOR TENDER PURPOSE ONLY

NTPC Ltd. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION

PROJECT: LARA STPP STAGE–II (2X8000MW) 400kV SWITCHYARD – PROTECTION SLD

TITLE: PROTECTION S.L.D. FOR LINE–TIE–LINE DIA

REV.NO.	DESCRIPTION	DESIGN	CHKD.	APPD	DATE	SIZE	SCALE	DRG. NO.	REV. NO.
						--	N.T.S.	9587-999-POE-J-006	2



NOTES:

1. The SWYD Inter bay bus shall be a ring or dual redundant star topology, fiber optic bus. (This diagram is showing a typical ring topology for one and half breaker configuration).
2. All network connections between rooms or buildings shall be via fiber-optic.
3. No. of ports in Ethernet Switches are indicative only, shall be finalized during detailed engg.
4. Minimum two no. spare port shall be available in each of the ES.
5. Minimum 27" inches monitor for OWS-1,2 and for all other monitors minimum 24" inches screen size to be provided.
6. LVS / LCD size shall be min 80" inches.
7. 4 Nos. ABT CLIENT PC / Web Licensed PC shall be placed as per owner's discretion within plant for owner's requirement.

LEGEND:-

MMI	MAN MACHINE INTERFACE	MU	MERGING UNIT
OWS	OPERATOR WORKSTATION	SCU	SWITCHGEAR CONTROL UNIT
BCU	BAY CONTROL UNIT	TSE	TIME SYNCHRONIZING EQUIPMENT
BPU	BAY PROTECTION UNIT	CER	CONTROL EQUIPMENT ROOM
I/O	INPUT AND OUTPUT	GIS CR	GIS CONTROL ROOM
LCC	LOCAL CONTROL CUBICLE	ES	ETHERNET SWITCH
I/O	INPUT AND OUTPUT	EM	ENERGY METERS ABT BASED
RLDC	REGIONAL LOAD DISPATCH CENTRE	EM	ENERGY METERS ABT BASED
H/W	REQUIRED HARDWARE FOR INTEGRATION SHALL BE SUPPLIED BY THE BIDDER	DCU	DATA CONCENTRATOR UNIT
		GPS	GLOBAL POSITIONING SYSTEM

FOR TENDER PURPOSE ONLY

OWNER: NTPC LTD.

PROJECT: LARA TPP STAGE-II(2X800MW)

TITLE: SUBSTATION AUTOMATION SYSTEM ARCHITECTURE

Design: | Checked: | Approved:

Date: | Drg No. 9587-999-POE-J-003 | Rev No. 03