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**SECTION-A**

**GENERAL**

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1. GENERAL

This specification covers the design, manufacture, test and inspection at manufacturer's shop 1 set(s) of steam turbine (HP&LP ST) and accessories.

2. SITE CONDITIONS

Ambient temperature	:	Maximum Extreme:	122 deg. F ( 50 deg. C)
Annual humidity	:	Maximum	85 %
Altitude (above sea level)	:	Maximum	3000 feet ( 914. 4 m )
Installation Place	:	OUTDOOR	
Noise Limitation	:	92 dB (A)	at one(1) meter at each equipment

3. UNIT AND LANGUAGE

All documents and drawings will be described in English and all dimensions will be shown in Metric units.

4. TEST AND INSPECTION

Test and inspection for turbine and aux. equipment will be carried out at the manufacturer's shop, in accordance with the manufacturer's standard inspection practice, before shipment and they shall be final.

5. PAINTING COLOR

The painting color will be as follows.

Steam turbine and accessories	:	Munsell 2. 5G 6/3
Steam pipe and turbine casing	:	Silver
Turbine panel & Junction box	:	Munsell 5Y7/1 (RAL 7032)

Munsell : JAPAN PAINT INDUSTRY ASSOCIATION STANDARD COLORS denomination

6. PACKING

All the equipment and its accessories shall be packed in accordance with our standard practice for export shipment, so as to avoid any loss or damage during transportation and rough handling.

7. WARRANTY

All equipments covered in this specification shall be guaranteed for operation under normal operation conditions. The guaranteed covers defective design, materials and workman ship only and shall not be applicable to damages sustained through misuse of the equipment.

The covered defects shall be made good by us at no charge to the client. But the guarantee period is for a period of twelve (12) months after the Final Acceptance or eighteen (18) months from the date of shipment (B/L date), whichever comes earlier.

In no event the seller shall be liable for any incidental or consequential damages such as , but not limited to loss of revenue, production or use of any equipment, resulting from any cause.

8. RULES AND STANDARDS

The turbine-generator set shall be designed and manufactured in accordance with the following rules and standards.

- JIS : Japanese Industrial Standard
- JEC : Standard of The Japanese Electrical Committee
- JEM : The Standards of the Japan Electrical Manufacturer's Association and other Japanese Standard.

Manufacture's Standard practice

All screw, bolts and nuts shall conform to the metric thread system of ISO (International Standard Organization).

And also, following codes will be applied:

- NEMA - National Electrical Manufacturers Association, including SM-24 "Land based steam turbine generator sets 0-33,000kW"
- ANSI - American National Standards Institute, including: TDP-1 "Recommended practices for prevention of water damage to steam turbines used for electric power generation"

\* Pressure Vessel for ASME SEC VIII

9. MODIFICATION

The price quoted (separately) is for equipment as specified herein. Any deviation from this specification may require a price modification, upwards or downwards.

10. OUT OF SCOPE

*This proposal includes only the items specified-herein and specifically excludes the following equipments, materials and work which are to be provided by the purchaser.*

1. Civil works
2. Equipment foundation and it's mechanical strength calculation
3. Embedded parts in foundation(s) of equipment (Loading data will be submitted by SNM)
4. Erection and commissioning of equipment
5. Welding rods, paints and other material for the installation work and start- up operation
6. Maintenance stair case, ladder, stage, hand rail and etc.
7. Earthing device
8. Air conditioning equipment
9. Fire extinguishing system
10. Compressed air supply system
11. Overhead traveling crane. (for erection and/or maintenance)
12. Supervising for erection and commissioning for quoted equipment (Separate quotation)
13. Consumable materials, such as grease, flushing oil, lubrication oil, waste, etc.
14. Piping and valve not specified in this specification
15. Wiring materials and works for electricity and instrument not specified this specification
16. All other equipment, materials and works not specified in this specification
17. TURBINE CONTROL PANEL (OPTION)
18. DCS system
19. HP & LP feedwater heaters, Deaerator, BFWP(s), if any
20. Turbine By-pass station (PRDS) or PRDS for process steam and for Deaerator
21. Flow measuring device for steam & cooling water
22. Isolation valves for all steam & cooling water line
23. Inlet steam, extraction(if any), exhaust steam piping
24. Cooling water supply system with piping
25. Instruments air and service air tubing/piping
26. Companion flange(with fasteners) at all terminal points
27. Generator, Power cable between generator and circuit breaker panel
28. Inter-connecting piping(s) between turbine and gland condenser, if any
29. Inter-connecting piping(s) between condenser and air ejector/condenser, if any
30. Inter-connecting piping(s) between condenser and hotwell level control valve, if any
31. inter-connecting wiring between local and local panel, remote panels(if any)
32. DC battery and Battery Charger
33. UPS system
34. Recommended operational spare parts (Option)
35. Oil purifier
36. MCC, AC motor starter / DC motor starter
37. Expansion Joint for steam line
38. Drain separator for steam line, if any
39. Drain tank and drain transfer pump for exhaust piping
40. Flow measuring device (inlet steam, extraction(if any))
41. Condensing System
42. Vacuum System for Condenser
43. 2x 100 % Condensate extraction pump with AC motor
44. Level Control Valve for Condenser Hotwell with controller
45. Minimum circulation control valve
46. Safety Valve for steam line

NOTE : 1. Supply limit shall be described on the "P & I DIAGRAM".

2. Scope of supply, which is not described in this specification, is not quoted by us.

## 11. STEAM QUALITY

Deposits on the turbine blading due to steam contamination may bring about thermodynamical and mechanical disturbances. Moreover, if chlorides are involved under certain circumstances blade fractures might occur.

Corrosion depending strain, caused by aggressive deposits, affects above all in the state of commencing steam wetness the alternating bending strength of the blade material.

These recommendations concerning the steam quality are in line with the guide lines for continuous turbine operation issued by the VGB (Vereinigung der Großkesselbetreiber in Deutschland).

On principle the guide lines should be complied with as far as practicable. The expenses for the relevant water treatment are to be seen in comparison with possible repair and stoppage costs if the turbine suffers damage from contaminated steam.

To avoid misunderstandings we point out that even full compliance with the guide lines does not guarantee absolutely safe a depositfree turbine. The steam contaminations and their portion of mixture represent the most essential factor as to precipitation, however, this problem is not fully solved up to now. If there is a chance to improve the steam cleanliness in comparison with the guide lines, make use of it.

### Guide Lines for inlet steam condensate

Testing as to	Unit	Guide Lines	
		Continuous Operation +)	Start-up Operation ++)
Conductivity at 25°C for CO <sub>2</sub> -free waters	μS/cm	≤ 0.2	< 0.5
Silica (SiO <sub>2</sub> )	p. p. m	< 0.02	< 0.05
Total-iron (Fe)	p. p. m	< 0.02	< 0.05
Copper (Cu)	p. p. m	< 0.003	< 0.01
Sodium + Potassium (Na) (K)	p. p. m	< 0.01	< 0.02

+) The values are in line with the VGB-guide lines, edition April 1972. As to further details and descriptions see also there.

++) A falling tendency must be noticeable. On commissioning of new plants the values for continuous operation must be achieved after two days and the values for for start-up operation after two hours. Routine commissioning requires full compliance with the start-up values at the point of roll-off whereas the continuous operation values must be attained after 2 hours.

### Supervision

Continuous monitoring of the water/steam system by means of recording instruments is strictly recommended for the electrical conductivity at 25°C and for the Silica content. The monitoring instruments should be provided on the inlet steam and on the exhaust steam side.

SECTION - B

SPECIFICATION OF STEAM TURBINE

INDEX

1. Specification of Steam Turbine and Accessories
2. Material List
3. Instrumentation
4. Scope of Supply
5. Special Tools
6. Commissioning Spare Parts

1. SPECIFICATION OF STEAM TURBINE AND ACCESSORIES1-1. Type of Steam Turbine :

Type : Horizontal, impulse, multi-stage  
multi-valve, axial flow, geared  
double casing & bleed extractions  
re-heated condensing turbine

1-2. Output :

Rated output : (at generator terminal)	:	<u>52,000</u>	kW	
HP TURBINE OUTPUT	:	<u>14,600</u>	kW	◇ (At RG output shaft)
LP TURBINE OUTPUT	:	<u>38,300</u>	kW	◇ (At Turbine output shaft)
TOTAL OUTPUT FROM TURBINE	:	<u>52,900</u>	kW	
Calculated Generator Efficiency	:	<u>98.3</u>	%	

1-3. Operating Conditions :

Speed (HP turbine/generator)	:	<u>5000/3600</u>	rpm	
(LP turbine/generator)	:	<u>3600</u>	rpm	
Inlet steam pressure	:	<u>1400</u>	psi. G	
Inlet steam temperature	:	<u>730</u>	deg F	◇
Max. 1st extraction press. (Un-controlled extraction)	:	<u>489</u>	psi. G	
HP exhaust / 2nd extraction	:	<u>310</u>	psi. G	
LP inlet steam press.	:	<u>300</u>	psi. G	
LP Inlet steam temperature	:	<u>730</u>	deg F	
Max. 3rd extraction press. (Un-controlled extraction)	:	<u>80</u>	psi. G	
Max. 4th extraction press. (Un-controlled extraction)	:	<u>20</u>	psi. G	
Exhaust steam pressure	:	<u>2.7</u>	inHgA	
Rated Inlet flow	:	<u>479,500</u>	Lb/hr	◇
Rated 1st extraction flow	:	<u>31,135</u>	Lb/hr	◇
Rated 2nd extraction flow	:	<u>33,088</u>	Lb/hr	◇
Rated 3rd extraction flow	:	<u>46,968</u>	Lb/hr	◇
Rated 4th extraction flow	:	<u>43,197</u>	Lb/hr	◇
Rated Exhaust steam flow	:	<u>324,622</u>	Lb/hr	◇

at 2.7 inHgA

PERFORMANCE TABLE    ◊

<u>OPERATION CASE</u>		<u>1</u>			
		<u>RATED</u>			
<u>HP TURBINE</u>					
Inlet steam Pressure	( psi. G )	<u>1400</u>			
Temperature	( deg F )	<u>730</u>			
Flow (*)	( Lb/hr )	<u>479, 500</u>			
1st Bleed Extraction	( Un-Controlled Extraction )				
Pressure	( psi. G )	<u>488. 7</u>			
Temp	( deg F )	<u>513. 7</u>			
Extraction Flow	( Lb/hr )	<u>31, 135</u>			
Exhaust press	( psi. G )	<u>310</u>			
Exhaust temp	( deg F )	<u>433. 7</u>			
Intermediate Gland leakage to bleed line	( Lb/hr )	<u>2, 098</u>			
2ND Bleed Extraction	( Un-Controlled Extraction )				
Extraction Flow	( Lb/hr )	<u>33, 088</u>			
<u>LP TURBINE</u>					
Inlet steam Pressure	( psi. G )	<u>300</u>			
Temperature	( deg F )	<u>730</u>			
Flow (*)	( Lb/hr )	<u>412, 829</u>			
3RD Bleed Extraction	( Un-Controlled Extraction )				
Pressure	( psi. G )	<u>80</u>			
At LP turbine nozzle	( Lb/hr )	<u>44, 870</u>			
From HP turbine glands	( Lb/hr )	<u>2098</u>			
Temp	( deg F )	<u>486. 3</u>			
Extraction Flow	( Lb/hr )	<u>46, 968</u>			
4TH Bleed Extraction	( Un-Controlled Extraction )				
Pressure	( psi. G )	<u>20</u>			
Temp	( deg F )	<u>310. 8</u>			
Extraction Flow	( Lb/hr )	<u>43, 197</u>			
Exhaust press	( inHgA )	<u>2. 7</u>			
Exhaust temp	( deg F )	<u>111. 4</u>			
Gland leakage	( Lb/hr )	<u>490</u>			
Exhaust flow	( Lb/hr )	<u>324, 622</u>			
Generator power	( KW )	<u>52, 000</u>			

REMARKS

- (\*) The measured steam consumption figures are subject to a tolerance margin of  $\pm 3$  % for instrumentation and human errors.
- Guarantee Point: case 1

1-4. Direction of Rotation : (Viewed from Turbine to Condenser)

HP Steam turbine	:	<u>C. C. W.</u>
LP Steam turbine	:	<u>C. W.</u>
Generator	:	<u>C. W. (CCW looking from non-exciter side)</u>

1-5. Lubrication, Governor and control oil :

Type of lubrication	:	<u>Forced lubrication</u>
Lubrication oil pressure	:	<u>15</u> psi. G ( 1.06 kg/cm <sup>2</sup> g)
Trip oil pressure	:	<u>60</u> psi. G ( 4.22 kg/cm <sup>2</sup> g)
Control oil pressure	:	<u>340</u> psi. G ( 23.9 kg/cm <sup>2</sup> g)
Normal required oil flow		
Lube and trip oil	:	<u>870</u> Lit/min
Control oil	:	<u>100</u> Lit/min
Kind of oil	:	<u>Turbine oil ISO VG46</u>

Note : Lube oil flow & heat loss for Generator have to be informed to SNM.

1-6. Mechanical Design Condition :

HP ST Inlet steam section	:	<u>1600</u> psi. G ( 112.5 kg/cm <sup>2</sup> g)	<u>765</u> deg F ( 407 deg. C)
1st Extraction	:	<u>540</u> psi. G ( 38 kg/cm <sup>2</sup> g)	<u>720</u> deg F ( 382 deg. C)
2nd Extr. (HP ST exhaust)	:	<u>340</u> psi. G ( 23.9 kg/cm <sup>2</sup> g)	<u>670</u> deg F ( 354 deg. C)
LP ST Inlet steam section	:	<u>340</u> psi. G ( 23.9 kg/cm <sup>2</sup> g)	<u>750</u> deg F ( 399 deg. C)
3rd Extraction	:	<u>125</u> psi. G ( 8.8 kg/cm <sup>2</sup> g)	<u>650</u> deg F ( 343 deg. C)
4th Extraction	:	<u>80</u> psi. G ( 5.6 kg/cm <sup>2</sup> g)	<u>400</u> deg F ( 204 deg. C)
Exhaust steam section	:	<u>13</u> psi. G ( 0.9 kg/cm <sup>2</sup> g)	<u>300</u> deg F ( 149 deg. C)
Cooling water section	:	<u>70</u> psi. G ( 4.9 kg/cm <sup>2</sup> g)	<u>175</u> deg F ( 79 deg. C)
Instrument air section	:	<u>130</u> psi. G ( 9.1 kg/cm <sup>2</sup> g)	<u>120</u> deg F ( 49 deg. C)

1-7. Flange Size

				<u>Nozzle orientation</u>	
				(Viewed from HP Turbine to Gene.)	
Steam inlet nozzle	1500LB	:	<u>250</u> mm ( 10 inch )	<u>RIGHT</u>	
1st Extraction	600LB	:	<u>100</u> mm ( 4 inch )	<u>RIGHT</u>	
HP turbine outlet	300LB	:	<u>400</u> mm ( 16 inch )	<u>TOP</u>	
LP turbine inlet	300LB	:	<u>350 x 2</u> mm ( 14 inch x 2)	<u>RIGHT</u>	
3rd Extraction	150LB	:	<u>250</u> mm ( 10 inch )	<u>RIGHT</u>	
4th Extraction	150LB	:	<u>300</u> mm ( 12 inch )	<u>TOP</u>	
Exhaust nozzle	PN2.5	:	<u>2800</u> mm ( 112 inch )	<u>AXIAL</u>	

SNM provide ASME dimension flanges (inch size) for all terminal points, except for TURBINE EXHAUST.

ASME don't have large size flange of DN2800 (112 inches), hence we provide ISO PN2.5 flange. This is our standard size for C10 model Axial-Exhaust turbine, hence it cannot be changed.

1-8. Approximate Weight (Dry) :

HP TURBINE with RG & Baseplate	:	<u>25,000</u> kg	(Approximate)
LP turbine with base plate	:	<u>49,500</u> kg	(Approximate)
Oil unit	:	<u>10,000</u> kg	(Approximate)
Others	:	<u>7,000</u> kg	(Approximate)

1-9. Reduction Gear

Type : Horizontal, Single reduction.  
 Double helical gear type  
 Capacity : 15000 kW  
 Service factor : AGMA 1.1  
 Applied standards : JIS , AGMA  
 Noise : 92 dB (A) at 1.0m  
 Quantity : One (1) set / One unit

1-10. Emergency Stop Valve

Type : Oil pressure operated type with  
 steam strainer and limit switch for  
 indication of closed position.  
 Quantity : One (1) sets / One unit

1-11. Journal BearingFOR HP TURBINE

Type : Tilting Pad type, forced lubricated  
 Quantity : Two (2) sets / One unit

FOR LP TURBINE

Type : Tilting Pad type, forced lubricated  
 Quantity : Two (2) sets / One unit  
 (DE side journal bearing is combined  
 with thrust bearing)

1-12. Thrust BearingFOR HP TURBINE

Type : Multi-segment tilting pad type  
 (Kingsbury type)  
 Quantity : One (1) set / one unit  
 (Double side)

FOR LP TURBINE

Type : Multi-segment tilting pad type  
 (Kingsbury type, combined with  
 journal bearing)  
 Quantity : One (1) set / one unit  
 (Double side)

1-13. Speed Governor

Type : Electro-Hydraulic Governor  
 Model No. /Mfr name : Simplex Electrical Governor / WOOD WARD  
 Adjustable speed range : 105-95% of rated speed  
 ( 105% Max speed limit)  
 Speed regulation : 4% as droop  
 Max. speed rise : Less than overspeed setting  
 NEMA CLASS : D

1-14. Oversped Governor

Type : Mechanical eccentric trip weight  
& Electric signal from governor,  
2 out of 3 voting Electrical OST device  
(Protech 203)

Tripping speed : 109 % of rated speed (Electric)  
110±1% of rated speed (Mechanical)  
110±1% of rated speed (Protech 203)

Quantity : Each One (1) set / One unit

1-15. Governing valve :At HP turbine inlet

Type : Bar lif and MULTI VALVE TYPE

Quantity : 1 / One unit

At LP turbine inlet (as intercept valve)

Type : Bar lif and MULTI VALVE TYPE

Quantity : 1 / One unit

1-16. Insulation and Jacketing

Turbine casing and emergency stop valve are insulated and jacketed to maintain jacket temperature below 167 deg F.

1-17. Coupling :

Coupling between HP turbine and R/gear : Diaphragm type

Coupling between R/gear and generator : Diaphragm type

Coupling between LP turbine and generator : Diaphragm type

1-18. Base Plate or Sole plate

Type

for HP Steam turbine : Baseplate

for Reduction gear : Common with HP turbine baseplate

for LP turbine : Baseplate

1-19. Turning Device1-19-1. ON HP TURBINE R. GEAR

Type : Electric (AC) motor driven,  
Combined of Cyclo & Bevel Gear or  
worm gear reduction, automatic engaged  
and automatic disengagement.

Motor rating : Refer to attached utility list

Quantity : One (1) set / One unit

1-19-2. ON LP TURBINE

Type : Hand-drive turning device  
for alignment purpose.

Quantity : One (1) set / One unit

1-20. Oil Reservoir

Type : Steel plate fabricated type

Full capacity : 4 minutes of normal required  
flow at least

Quantity : One (1) set / One unit

Reservoir is furnished with oil level indicator, drain valve, oil charging nozzle,  
gas vent fan, Oil heater.

1-21. Lube Oil Pump (Main & Aux.)

Type : Gear type, driven by AC electrical motor  
and mounted on the top of oil reservoir.

Capacity : 1.1 times of required lube oil flow  
, as minimum.

Discharge pressure : 72 psi. G ( 5.07 kg/cm<sup>2</sup>g)

Quantity NO. 1 LOP : One (1) set / One unit

NO. 2 LOP : One (1) set / One unit

1-22. Control Oil Pump

Type : Screw type, driven by the AC motor,  
and mounted beside of oil reservoir.

Capacity : 1.1 times of required lube oil flow  
, as minimum.

Discharge pressure : 355 psi. G ( 25 kg/cm<sup>2</sup>g)

Motor rating : Refer to attached utility list

Quantity NO. 1 COP : One (1) set / One unit

NO. 2 COP : One (1) set / One unit

1-25. Emergency Oil Pump

Type : Gear type mounted on oil reservoir  
and driven by AC electric motor

Quantity : One (1) set / One unit

Note : UPS should be used for Electrical source of this motor.

1-26. Oil Cooler

Type : Shell and tube, fixed tube sheet type

Cooling water - Kind : Fresh water

- Quantity : Refer to attached utility list

Cooling Surface : 100% of required area

Quantity : 2 set(s)/one unit

1-27. Lube Oil Filter

Type : Duplex with change-over cock

Filtration : 40 micron

Quantity : One (1) set / One unit  
(twin element)

1-28. Control Oil Filter

Type : Duplex with change-over cock

Filtration : 20 micron

Quantity : One (1) set / One unit  
(twin element)

1-29. Oil Pressure Adjusting Valve

Type : Self acting type

Setting pressure

-Lube oil : 15 psi.G (1.1 kg/cm<sup>2</sup>g)

-Trip oil : 60 psi.G (4.2 kg/cm<sup>2</sup>g)

-Control oil : 340 psi.G (23.9 kg/cm<sup>2</sup>g)

Quantity : 1 lot / One unit

1-30. Gland Steam Condenser

Type : Shell and tube, fixed tube sheet type  
with AC motor driven exhaust fan

Cooling water - Kind : Cooling Tower Water

- Quantity : Refer to attached utility list

Quantity

- exhaust fan : 1 set(s)/one unit

- condenser : 1 set(s)/one unit

- exhaust fan : 1 set(s)/one unit

- condenser : 1 set(s)/one unit

Ac motor driven exhaust fan on Gland Condenser will extract the air from Gland Condenser inside.

By this fan, the pressure of gland condenser shell's inside is maintained to app. -300 mmAq (slightly vacuum) so that turbine gland leak steam is extracted to gland condenser.

2. MATERIAL LIST2-1-1. HP Stem Turbine

Turbine casing part	:	Cast carbon steel
Turbine rotor	:	Cr-Mo forged steel
Blades	:	Mo-13% Cr stainless steel
Nozzles	:	Mo-13% Cr stainless steel
Diaphragm	:	Carbon steel
Journal bearing	:	Carbon steel lined with babbitt metal
Thrust bearing	:	Carbon steel lined with babbitt metal
Bearing housing	:	Cast iron
Labyrinth packing	:	Ni-Pb-Bronze or stainless steel fin

2-1-2. LP Stem Turbine

Turbine HP casing part	:	Cast carbon steel
Exhaust casing part	:	Carbon Steel
Turbine rotor	:	Cr-Mo forged steel
Blades	:	Mo-13% Cr stainless steel
Nozzles	:	Mo-13% Cr stainless steel
Diaphragm	:	Carbon steel
Journal bearing	:	Carbon steel lined with babbitt metal
Thrust bearing	:	Carbon steel lined with babbitt metal
Bearing housing	:	Cast iron
Labyrinth packing	:	Ni-Pb-Bronze or stainless steel fin

2-2. Emergency Stop Valve

Body	:	Cast carbon steel
Valve	:	Cr-Mo steel
Valve seat	:	Stainless steel
Strainer	:	Stainless steel

2-3. Governor Valve

Body	:	Cast carbon steel
Valve	:	Stainless steel
Valve seat	:	Stainless steel

2-4. Reduction Gear

Casing	:	Cast iron
Pinion	:	Forged alloy steel
Wheel gear	:	Forged alloy steel
Wheel shaft	:	Alloy steel
Journal bearing	:	Steel lined with babbitt metal
Thrust bearing	:	Steel lined with babbitt metal

2-5. Oil Cooler :

Shell	:	Carbon steel
Tube	:	Copper
Tube sheet	:	Carbon steel plate
Water chamber	:	Cast iron

2-6. Oil Pump

Casing	:	Cast iron
Rotor	:	Carbon steel

2-7. Oil Filter

Casing	:	Cast iron or carbon steel for lube oil filter Carbon steel for control oil filter
Element	-for Lube oil filter	: 18-8 stainless steel
	-for control oil filter	: Cartridge paper or fiber filter

2-8. Base Plate or Sole plate : Carbon steel plate

2-9. Piping

Pipe for inlet steam line	:	By other
Pipe for extraction steam lin	:	By other
Pipe for condensate water lin	:	Carbon steel
Pipe for gland leakage line	:	Carbon steel
Pipe for lube oil and control	:	Carbon Steel for upstream of oil filter, Return Stainless Steel for downstream of oil filter

2-10. Gland Steam Condenser

Shell	:	Carbon steel
Tube	:	Aluminum brass
Tube sheet	:	Carbon steel plate
Water chamber	:	Carbon steel plate

## 3. INSTRUMENTATION

## 3-1. Protection Schedule

No.	Protection Device	Alarm	Trip
1	Overspeed of turbine		○
2	Low lube oil pressure	○	○
3	Low control oil pressure	○	○
4	Hand trip		○
5	Remote trip		○
6	High lube oil temperature	○	
7	High bearing temperature	○	○
8	Excessive vibration	○	○
9	Excessive axial displacement	○	○
10	High HP turbine exhaust pressure	○	○
11	High LP turbine exhaust pressure	○	○
12	Failure, control loop of governor		○
13	High diff. pressure of lube oil filter	○	
14	High diff. pressure of control oil filter	○	
15	Oil reservoir level low	○	
16	Inlet Steam Pressure Low	○	
17	Inlet Steam Temperature Low	○	
18	LP turbine Inlet Steam Temp Low	○	

## 3-2. Instruments Arrangement

DESCRIPTION	SENSOR	INDICATION		ALARM	TRIP	SIGNAL TO CUSTOMER'S DCS
		LOCAL or LGB	REMOTE *1	REMOTE *1	REMOTE *1	
<b>MAIN INLET STEAM :</b> PRESSURE TEMPERATURE	TE	PIT TIT	PI TI	L L		● ●
<b>1ST EXTRACTION :</b> PRESSURE TEMPERATURE	TE	PIT TIT	PI TI			● ●
<b>HP TURBINE EXHAUST STEAM :</b> PRESSURE  TEMPERATURE	PS  TE	PIT TIT	PI TI	H	HH	● ● ●
<b>LP TURBINE INLET STEAM :</b> PRESSURE TEMPERATURE	TE	PIT (x2) TIT (x2)	PIx2 TIx2	L		● ●
<b>3RD EXTRACTION :</b> PRESSURE TEMPERATURE	TE	PIT TIT	PI TI			● ●
<b>4TH EXTRACTION :</b> PRESSURE TEMPERATURE	TE	PIT TIT	PI TI			● ●
<b>LP TURBINE EXHAUST STEAM :</b> PRESSURE  TEMPERATURE FOR SPRAY WATER CONTROL	PS  TE TE	PIT TIT TIT	PI TI TI	H	HH	● ● ● ●
<b>HP TURBINE 1ST STAGE :</b> PRESSURE		PIT	PI			●
<b>GLAND SEAL :</b> PRESSURE		PIT	PIC			●
<b>GLAND LEAKAGE FOR HP &amp; LP TURBINE</b> PRESSURE		PIT x 2	PIx2			●
<b>DRAIN VALVES FOR TURBINE :</b> FOR INLET STEAM DRAIN FOR GOVERNOR VALVE FOR HP TURBINE 1ST STAGE FOR HP TURBINE EXHAUST FOR LP TURBINE INLET FOR LP TURBINE CASING DRAIN	ZS (CLOSE SIGNAL) ZS (CLOSE SIGNAL) ZS (CLOSE SIGNAL) ZS (CLOSE SIGNAL) ZS (CLOSE SIGNAL) ZS (CLOSE SIGNAL)		LAMP LAMP LAMP LAMP LAMP LAMP			● ● ● ● ● ●
<b>SEALING STEAM SUPPLY VALVE</b> FULL CLOSE	ZS (CLOSE SIGNAL)		LAMP			●
<b>EXTRACTIONS</b> <b>NON-RETURN VALVE</b> <b>POSITION :</b> YES		ZS	LAMP			●
<b>OIL RESERVOIR :</b> LEVEL TEMPERATURE	LS	LG TG		L		●
<b>OIL COOLER :</b> WATER INLET TEMPERATURE WATER OUTLET TEMPERATURE		TG TG				
<b>LUBE OIL FILTER :</b> DIFFERENTIAL PRESSURE		PDIT		H		●
<b>CONTROL OIL FILTER :</b> DIFFERENTIAL PRESSURE		PDIT		H		●

DESCRIPTION	SENSOR	INDICATION		ALARM	TRIP	SIGNAL TO CUSTOMER'S DCS
		LOCAL or LGB	REMOTE *1	REMOTE *1	REMOTE *1	
<b>LUBE OIL :</b>						
PRESSURE AT HP TURBINE	PS	PIT	PI	L		●
PRESSURE AT LP TURBINE	PS	PIT	PI	L	LL	●
AT PUMP DISCHARGE	PS	PIT	PI	L (FOR CHANGE-OVER OF OIL PUMP)	LL	●
TEMPERATURE AFTER COOLER	TE	TIT		H		●
TEMPERATURE BEFORE COOLER	TE	TIT				●
<b>TRIP OIL :</b>						
PRESSURE		PIT				●
<b>CONTROL OIL :</b>						
PRESSURE AT TURBINE	PS	PIT		L		●
AT ESV	PS	PG			LL	●
AT PUMP DISCHARGE	PS	PIT		L (FOR CHANGE-OVER OF OIL PUMP)		●
<b>HP TURBINE :</b>						
Governor	○ (GOVERNOR IS SUPPLIED AS GOV. PANEL)					
BEARING TEMP.	TE (X4), RTD		TI**	H	HH	●
SPEED	SE (x2)		SI			●
VIBRATION (SHAFT)	VE (x2)		VI**	H	HH	●
AXIAL DISPLACEMENT	ZE (x1)		ZI**	H	HH	●
CASING METAL	TE (X1), RTD		TI			●
ESV POSITION	ZS (x2)		LAMP			●
OVERSPEED (MECHANICAL, ELECTRICAL)	ZS				HH	●
<b>TURNING DEVICE ON HP TURBINE :</b>						
ENGAGEMENT/DISENGAGEMENT	ZS		LAMP			●
<b>REDUCTION GEAR :</b>						
BEARING TEMP.	TE (X4), RTD			H	HH	●
<b>LP TURBINE :</b>						
BEARING TEMP.	TE (X4)		TI**	H	HH	●
VIBRATION (SHAFT)	VE (x4)		VI**	H	HH	●
AXIAL DISPLACEMENT	ZE (x1)		ZI**	H	HH	●
KEY PHASER	KE		**			●
SPEED	SE (x3)		PROTECH 203 (ACCOMMODATED IN GOV. PANEL)			
CASING METAL	TE (X1), RTD		TI			●
<b>GENERATOR</b>						
BEARING TEMP.	TE (X2), RTD		TI**	H	HH	●
<b>CONDENSING SYSTEM :</b>						
OUT OF SCOPE OF SUPPLY						

NOTE

- \*1 : TURBINE CONTROL PANEL & CONTROLLER has been quoted as option.
- \*2 : In case of that turbine control panel (TCP) is supplied by data communication between DCS and turbine PLC will be done by MODBUS COMMUNICATION using Allen-Bradley SLC or ControlLogix. Signals marked '●' will be available at DCS. (Allen Bradley PLC will be provided for Turbine control)
- \*\* : In case of that turbine control panel (TCP) is supplied by these turbine supervisory instruments are incorporated with Bentley 3500 monitoring system. (TCP is option)

ABBREVIATION

PIT	:	PRESSURE TRANSMITTER with indicator
PG	:	PRESSURE GAUGE (BOURDON TUBE)
PI	:	PRESSURE INDICATOR
PIC	:	PRESSURE INDICATOR CONTROLLER
PDIT	:	DIFFERENTIAL PRESSURE TRANSMITTER with indicator
TE	:	TEMPERATURE DETECTING ELEMENT (THERMO COUPLE OR RTD)
TIT	:	TEMPERATURE INDICATOR with indicator
TG	:	THERMO GAUGE
PS	:	PRESSURE SWITCH
ZS	:	LIMIT SWITCH
SE	:	SPEED SENSOR
VE	:	VIBRATION PROBE
ZE	:	POSITION PROBE
SI	:	SPEED INDICATOR
VI	:	VIBRATION INDICATOR
ZI	:	POSITION INDICATOR
●	:	SUPPLIED BY SNM
TCP	:	TURBINE CONTROL PANEL
GOV. P	:	GOVERNOR PANEL
C. P	:	CENTER PANEL (SUPPLIED BY CUSTOMER or OTHERS)

4. SCOPE OF SUPPLY (for one unit)4-1. HP STEAM TURBINE

- 1 set - Steam turbine proper
- 1 set - Turning gear (on Reduction Gear)
- 1 set - Electric motor for Turning gear
- 1 set - Emergency stop valve with steam strainer
- 1 set(s) - Multi type governor valve
  
- 1 set - Mechanical Overspeed governor device with hand trip device
- 1 set(s) - Hydraulic servo piston
- 2 sets - Output Coupling ( Turbine - R.G. & R.G. - Generator )
- 1 set - Baseplate for turbine & Reduction Gear
- 1 set - Lagging cover and jacketing (for turbine proper)
- 1 set - Steam piping within Baseplate
- 1 lot - Drain valve for turbine
- 1 set - Solenoid valve for remote trip
- 2 sets - Sight glass for return oil from turbine bearing housing
- 1 set - Reduction gear
- 1 set - Sight glass for oil return from reduction gear

4-2. LP STEAM TURBINE

- 1 set - Steam turbine proper
- 1 set - Hand turning device for alignment purpose
- 1 set(s) - Multi type governor valve (Intercept Valve)
- 1 set(s) - Hydraulic servo piston
- 2 sets - Output Coupling ( Turbine - Generator )
- 1 set - Baseplate for turbine
- 1 set - Lagging cover and jacketing (for turbine proper)
- 1 set - Steam piping within Baseplate
- 1 lot - Drain valve for turbine
- 2 sets - Sight glass for return oil from turbine bearing housing

4-3. GLAND SEAL SYSTEM

- 1 set - Sealing steam control valve along with stop valve  
(Gland sealing controller will be provided as option, in TCP)
- 2 sets - Gland Condenser with Gland Exhaust Fan for HP & LP turbine

4-4. EXTRACTION STEAM NON-RETURN VALVE

- 4 sets - Air assisted non-return valve for extraction steam lines

4-5. OILING SYSTEM

- 1 set - Oil reservoir
- 1 set - Drain valve for oil reservoir
- 1 set - Main lube oil pump with relief valve
- 1 set - Auxiliary lube oil pump with relief valve
- 1 set - AC motor for main lube oil pump, with coupling, and coupling cover
- 1 set - AC motor for aux. lube oil pump, with coupling, and coupling cover
- 2 sets - Control Oil Pump
- 2 sets - AC motor for main & aux control oil pump with coupling & coupling cover
- 2 sets - Suction valve for control oil pumps
- 1 set - Emergency oil pump with relief valve
- 1 set - AC motor for emergency oil pump, with coupling, and coupling cover
- 1 lot - Non-return valve for oil line
- 1 lot - Accumulator for lube oil line
- 1 set - Accumulator for control oil line
- 1 lot - Oil pressure adjusting valve
- 2 sets - Lube oil cooler assembly along with change over 2x3 way valve
- 1 set - Duplex oil filter for lube oil line with change-over cock
- 1 set - Duplex oil filter for control oil line with change-over cock
- 1 set - Oil Heater
- 1 set - Wax type temperature control valve
- 1 set - Valved connections for oil purifier, if any
- 1 set - Oil piping

4-6. OTHERS

- 1 set - Electrical Governor assembly (GOVERNOR PANEL)
- 1 set - Electrical Overspeed Trip Device (W/W Protech 203)
- 1 lot - Instrumentation (see "4-2. Instruments Arrangement")
- 1 set - Foundation bolts, nuts & shims for quoted equipments
- 1 set - Commissioning spare parts
- 1 set - Special tools

5. SPECIAL TOOLS (for One Unit)

1 pc	-	Driver for mechanical overspeed trip device setting
4 pcs	-	Guide bar for turbine casing lifting
1 set	-	Cleaning rod for oil cooler
1 set	-	Cleaning rod for gland condenser
10 pcs	-	Wood plugs for oil cooler
10 pcs	-	Wood plugs for gland condenser
1 pc	-	Driver for emergency stop valve
1 pc	-	Ratchet handle and socket for bendix coupling
1 set	-	Turbine Rotor Lifting Tool
1 set	-	Hand turning tool for LP turbine
1 lot	-	Casing bolt heater for large size turbine casing bolt

6. COMMISSIONING SPARE PARTS (for One Unit)

1 pcs	-	Gasket packing for Emergency stop valve
1 set	-	Gasket packing for Governor valve
1 set	-	Sheet packing for Oil Cooler & Sheet packing for Gland condenser
100 %	-	"O" ring for oil filters
4 pcs	-	Control oil filter element
1 set	-	Packing for coupling cover

SECTION - C

CONDENSING SYSTEM

INDEX

CONDENSING SYSTEM IS OUT OF SNM'S SCOPE OF SUPPLY

SECTION - D

GENERATOR

INDEX

Refer to Generator Vendor's specification.