LIFE ENHANCEMENT OF E&M EQUIPMENT THROUGH IMPROVISED O&M TECHNIQUES

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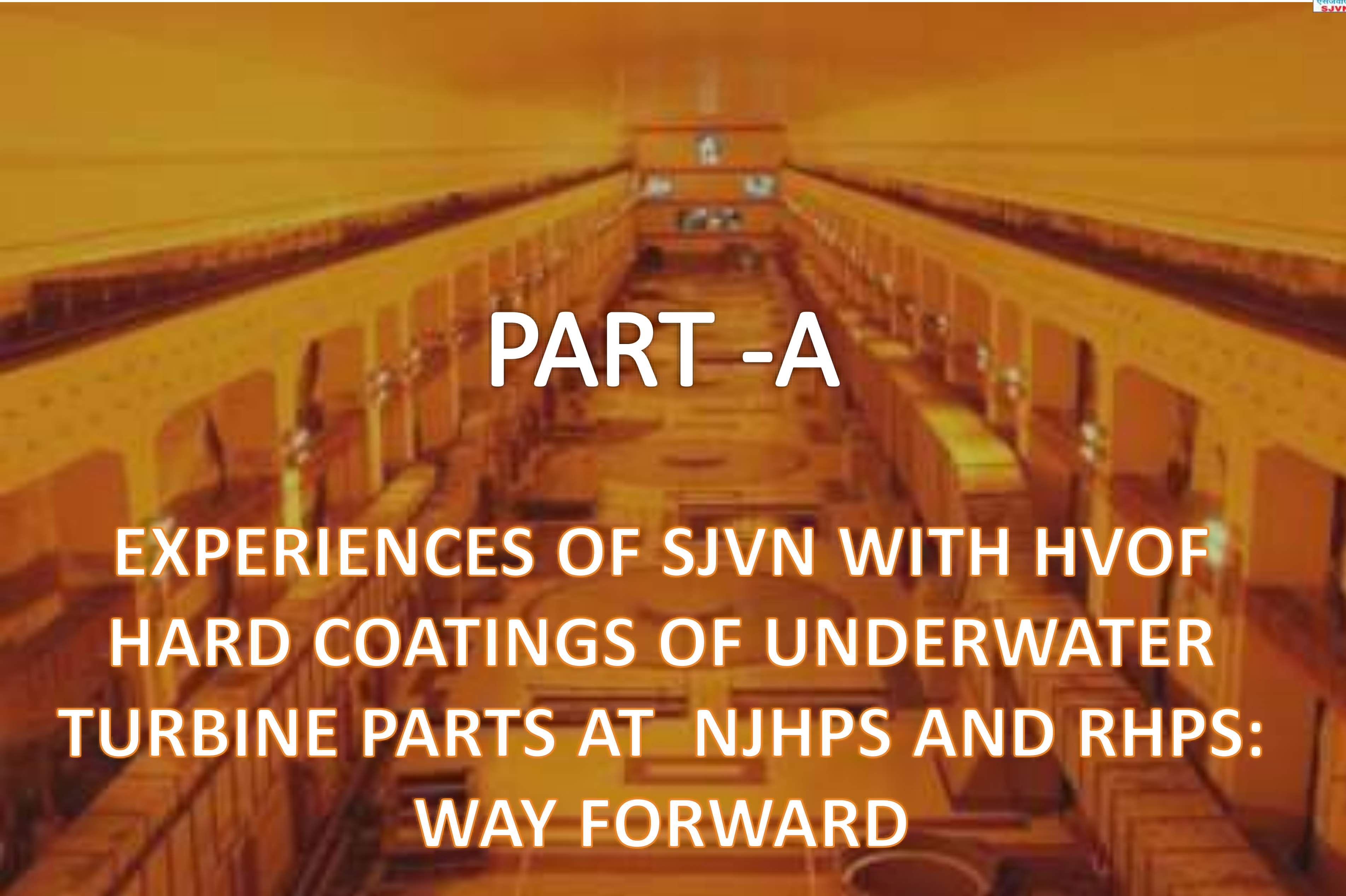
GM Electrical Design



PART -A

EXPERIENCES OF SJVN WITH HVOF HARD COATINGS OF UNDERWATER TURBINE PARTS AT NJHPS AND RHPS: WAY FORWARD

1. HVOF Coating

- **Tungsten Carbide**
  - **Typical Chemical Composition**
  - **Typical HVOF Parameters**

Innovations of SJVN

- Hard coating plant installed at NJHPS which is 1st ever hard coating plant provided at a Hydel Power house in the country

Hard coating workshop

robotic arm hard coating the guide vane

Hard coating workshop with 40T Turn table

- **Following components are under regular coating**
  - Guide vanes
  - Cheek plate
  - Labyrinth seal
  - Turbine Wear rings
  - Upper DT cone
  - Silt Flushing gate
  - GV Sealing ring

- **MOP has initiated policy interventions for setting up of such Hard Coating facilities by all Hydro Power Developer for their projects.**

NJHPS new runners (250 MW each) with coating

Hard coated runners of RHPS (68.67 MW each)

NJHPS runners (coated and uncoated)

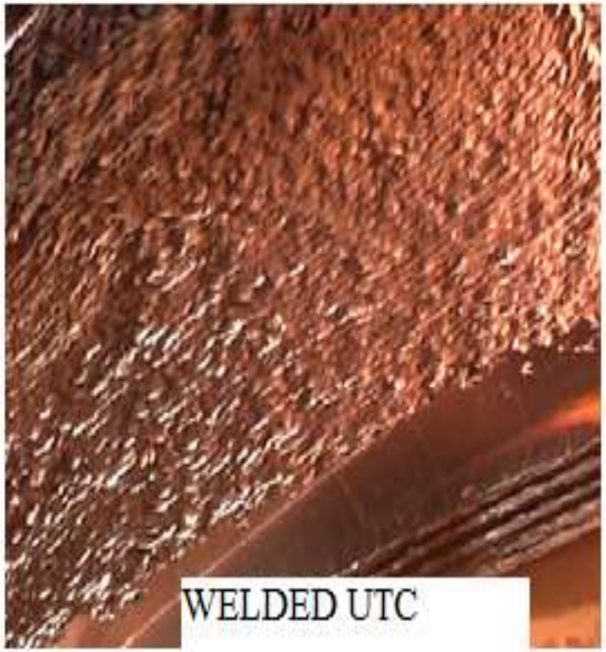
Original runner	New Runner
 uncoated 16:5 runner after one year of operation	 coated 13:4 runner after one year of operation

Runner materials

- Original runners were of 16:5 composition
- 4 new spare runners of 13:4 composition were procured in 2008
-

	Original runner	New Runner
Material Composition	X4CrNiMo 16-5-1 C max 0.06 Cr 15.0-17.0 Ni 4.0-6.0 Mo 0.80-1.50	X3CrNiMo 13-4 C max 0.05 Cr 12-14 Ni 3.5-4.5 Mo 0.3-0.7

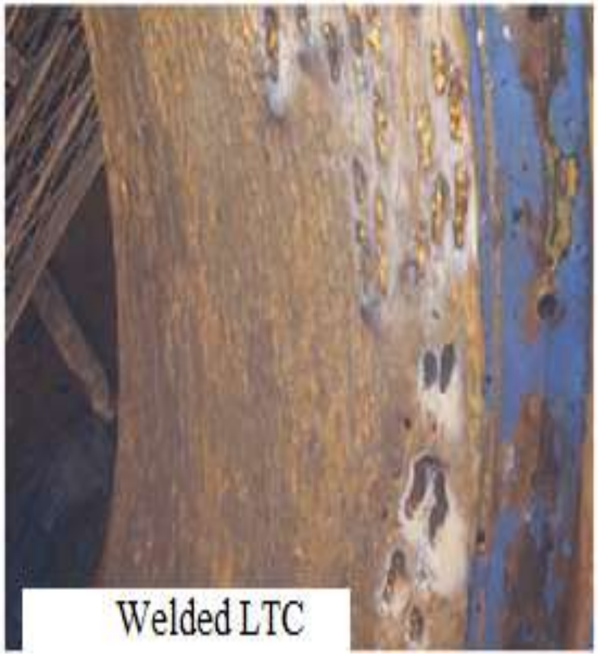
Other Innovations In Underwater Components



Innovative Repair Techniques

- Advanced coating in
  - Spiral casing
  - Stay rings and stay vanes
- In-situ Machining in
  - Upper Turbine cover/ top cover
  - Bottom Turbine cover/ Bottom ring
  - Sitting surface of Upper Labyrinth Seal Stationary (ULSS)

Bottom Turbine cover/ Bottom ring



Welded LTC

In Situ Machined LTC

In Situ machining

In Situ Machine in Progress

Sitting surface of Upper Labyrinth Seal Stationary (ULSS)

- Repeated failure of labyrinth was observed

Damaged ULSS

After Welding and Manual Grinding

In-Situ Machined ULSS

3. Repair and Maintenance

- Regular maintenance and cleaning is done to enhance the lifecycle and availability of the components.
- The welding is done with ESAB 309 Mo electrode.
- The profiles of over dimensional and non-removable components of hydro turbines were re-maintained through In-situ self-leveling machining using laser guidance.
- The repair of runner and guide vanes were carried out using templates to match original profile to the extent possible.

In-situ machining of Silt Flushing gates

What we achieved

- Enhancement in life of components
- Reliable and consistent performance throughout the annual operating cycle
- Less erosion in underwater parts and less maintenance time.
- Consistent generation both in NJHPS and RHPS above design value

Challenges ahead:

- To improve the quality of hard coating, its application, and continuous adoption of better materials
- To achieve two year repair cycle in place of one year repair cycle at present
- To achieve most optimal/ suitable combination of HVOF (Hard coating) and Soft Coating (Ceramics based brushable/ epoxy based combination coating) for enhancing the life of underwater components

PART -B

LIFE EXTENSION MEASURES FOR ELECTR-MECHANICAL EQUIPMENT: AN EXPERIENCE OF SJVN

SJVN'S EXPERIENCE OF LIFE EXTENSION MEASURES

AT NJHPS

(6X 250MW)

- **Retrofit of 400kV GIS**
- **Modernization of existing Bus Bar Protection scheme**

RATIONALE FOR R&M & LIFE EXTENSION

New Plants – costly, having longer gestation period.

Obsolescence due to technology upgradation.

R&M at lower costs and life extension achieved.

OBJECTIVE FOR R&M & LIFE EXTENSION

Exploit the design margins

Better spare management

Ease of operation

Life extension in cost effective manner

CHALLENGES TO R&M IMPLEMENTATION

R&M Solutions are complex and plant specific

Constraints in defining exact scope of work

Limited agencies for R&M implementation (OEM vs Others)

R&M activity to be associated with planned unit shutdown

Loss of Generation/ Availability

Retrofit and Extension of 400kV GIS

NEED

&

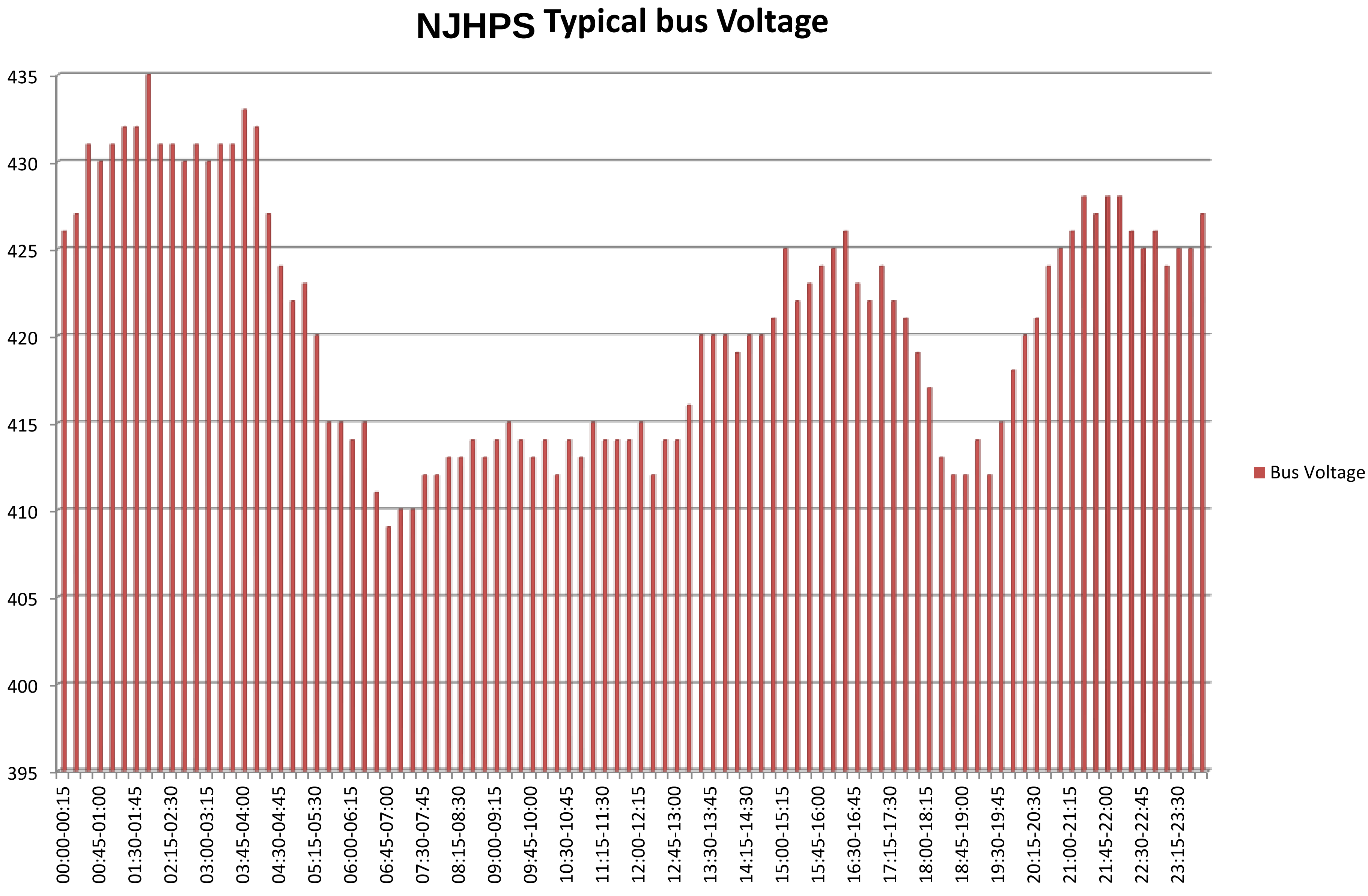
BENEFITS

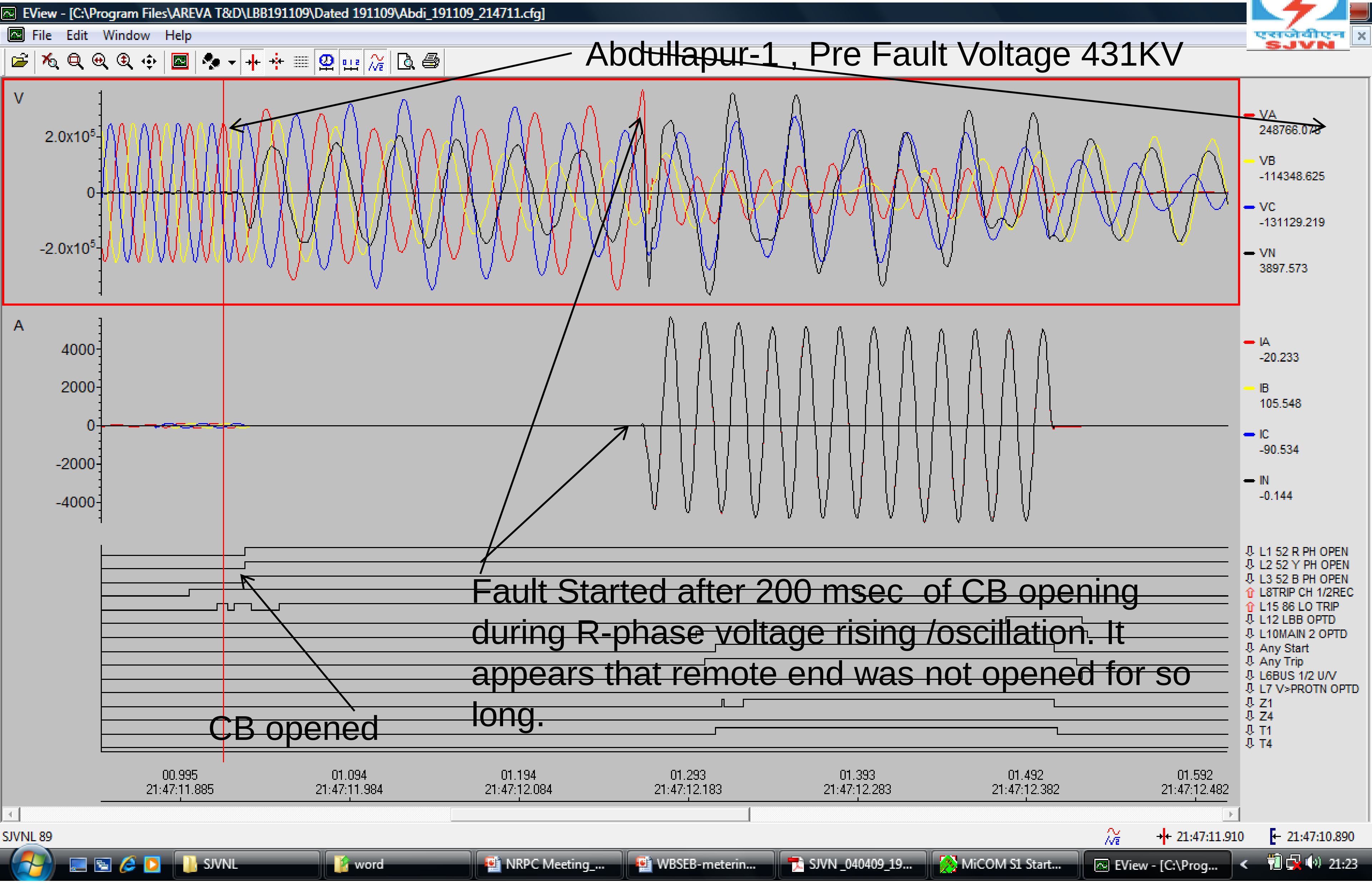
Equipment Failure History at NJHPS due to impact of Overvoltage during off Peak Seasons (Sept. to May)

A. B-Ph CB pole failure of NJ-Rampur(Ex NLG) on 12/07/03.
B. R-ph CB pole failure of NJ-KCW-I (Ex Baspa)on 10/02/05
C. B-Ph CB pole failure of NJ-Panchkula-I(ex ABD) on 04/04/09
D. R-PH CB pole failure of NJ-Panchkula-I on 19/11/09
E. R-Ph CB pole failure of NJ-KCW-II on 13/12/09
F. - R-Ph CB pole failure of NJ-Panchkula-I on 20/02/11

REMARK **SINCE 2011, SJVN HAS MANAGED TO MITIGATE THE FAULTS BY ADOPTING FREQUENT MONITORING OF SF6 ACIDITY LEVELS** ***OVER AND ABOVE THE MANUFACTURER'S RECOMMENDATIONS*****.**

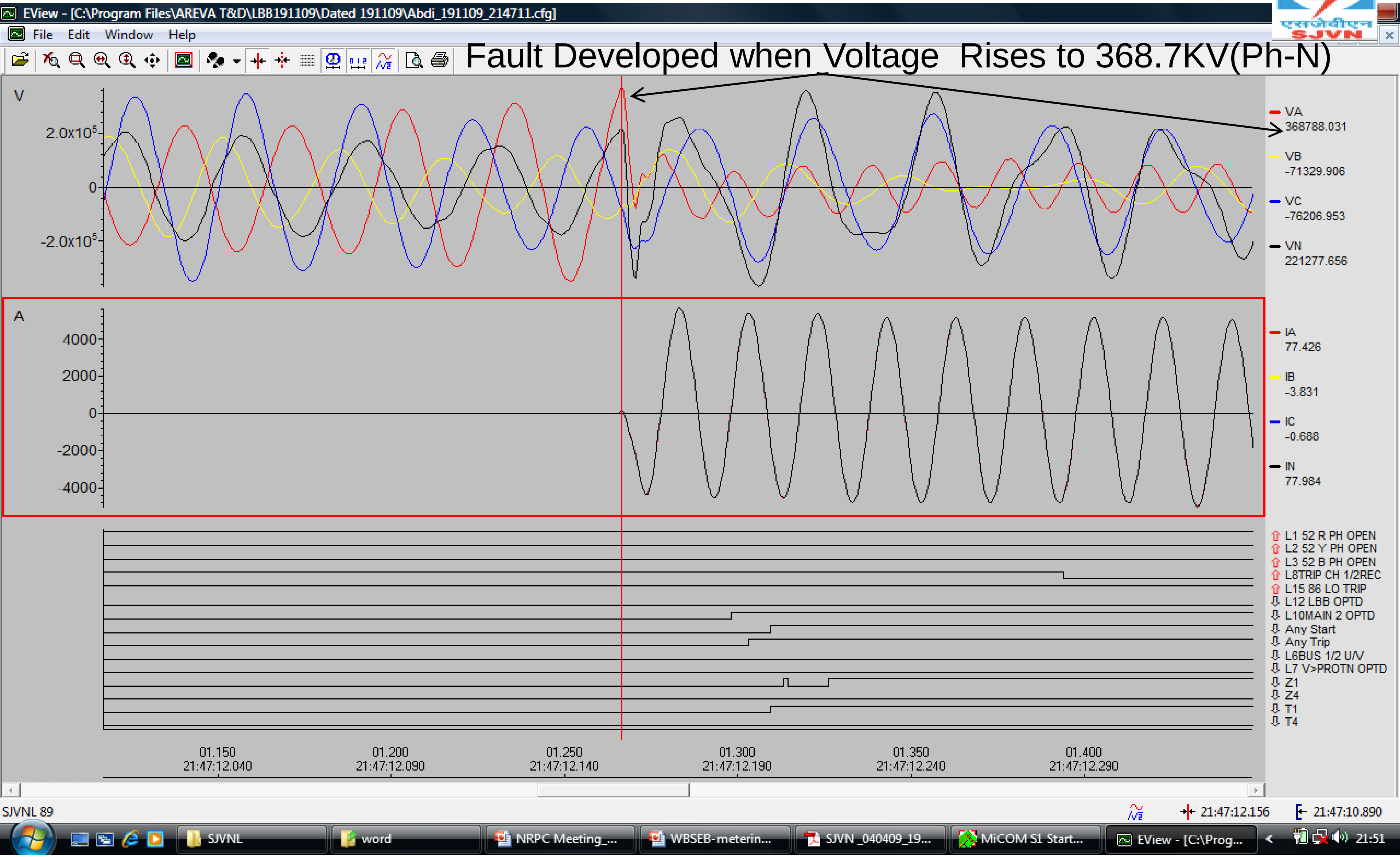
OVER VOLTAGES DURING OFFPEAK HOURS IN LEAN SEASON





EView - [C:\Program Files\AREVA T&D\LBB191109\Dated 191109\Abdi_191109_214711.cfg]
File Edit Window Help
Abdullapur-1 , Pre Fault Voltage 431KV
V
2.0x10^5
0
-2.0x10^5
VA 248766.078
VB -114348.625
VC -131129.219
VN 3897.573
A
4000
2000
0
-2000
-4000
IA -20.233
IB 105.548
IC -90.534
IN -0.144
L1 52 R PH OPEN
L2 52 Y PH OPEN
L3 52 B PH OPEN
L8TRIP CH 1/2REC
L15 86 LO TRIP
L12 LBB OPTD
L10MAIN 2 OPTD
Any Start
Any Trip
L6BUS 1/2 U/V
L7 V>PROTN OPTD
Z1
Z4
T1
T4
Fault Started after 200 msec of CB opening during R-phase voltage rising /oscillation. It appears that remote end was not opened for so long.
CB opened
00.995 21:47:11.885
01.094 21:47:11.984
01.194 21:47:12.084
01.293 21:47:12.183
01.393 21:47:12.283
01.492 21:47:12.382
01.592 21:47:12.482
SJVNL 89
21:47:11.910
21:47:10.890

Fault Developed when Voltage Rises to 368.7KV(Ph-N)



एसजेवीएन
SJVN

EFFECTS

HIGH FREQUENCY OF BREAKER FAULTS

FASTER RATE OF CONSUMPTION OF INITIAL SPARES

SPARE MANAGEMENT BECAME A BOTTLENECK FOR SJVN

THE NEED

- *RECOMMENDATIONS OF NRPC FOR REACTIVE COMPENSATION(80MVar Reactor at both NJHPS & RHPS)*
- *SPARE MANAGEMENT OF EXISTING OBSOLETE MODEL OF GIS EQUIPMENT*

THE PROPOSAL

- *EXTENSION OF 01 NEW 420KV GIS BAY FOR SWITCHING OF 80MVAR BUS REACTOR*
- *RETROFITTING OF EXISTING 01 NO. 420 KV GIS LINE BAY WITH LATEST AVAILABLE GIS CIRCUIT BREAKER.*

BENEFIT

ADAPTATION OF NEW TECHNOLOGY

THE SPARE FOR THE NEW MODEL BREAKER WOULD BE EASILY AVAILABLE, WHILE THE THREE POLES OF THE OLD GIS MODEL B-142 DISMANTLED C.B, AS WELL ITS HYDRAULIC OPERATING MECHANISMS, WOULD SERVE AS SPARE FOR THE EXISTING BAYS, LEADING TO SPARE MANAGEMENT IN COST EFFECTIVE MANNER FOR NEXT 5-10 YEARS.

PLANNING

AS BOTH 1500MW NJHPS AND 412MW RHPS OF SJVN ARE RUNNING IN TANDEM, LOSSES ASSOCIATED WITH THE DOWNTIME FOR INSTALLATION, TESTING AND COMMISSIONING HAD TO BE KEPT TO MINIMUM.

FOR RETROFIT ACTIVITY OF NEW BAYS AN INTERFACE BETWEEN OLD EQUIPMENT AND NEW INSTALLATION WAS REQUIRED, WHICH NECESSITATED COMPLETE SHUTDOWN OF BOTH BUSES AT NJHPS WHICH WOULD MEAN SHUTDOWN OF BOTH POWER HOUSES I.E NJHPS AND RHPS.

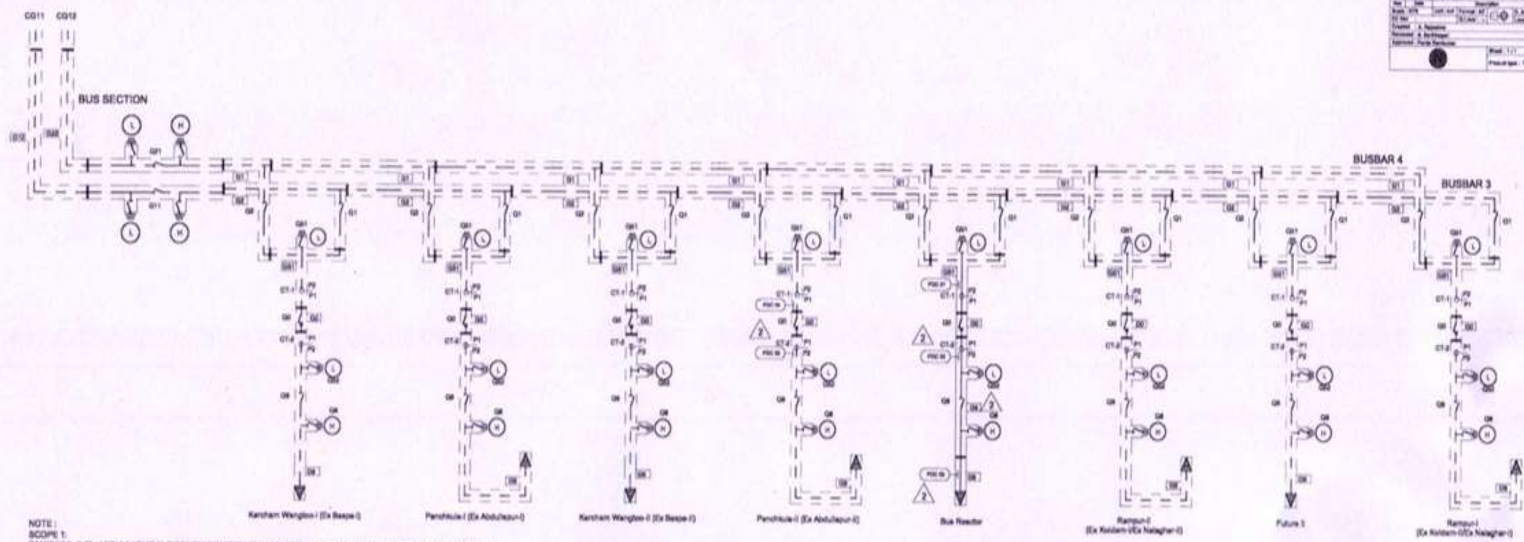
THE WHOLE ACTIVITY HAS BEEN PLANNED IN A THREADBARE MANNER AFTER WHICH IT HAS BEEN POSSIBLE TO SCHEDULE THE WHOLE ACTIVITY IN A SHUTDOWN OF 30HRS .

CONCLUSION

The road to R&M implementation has its own challenges & O&M engineers shall have to take a call to convert the adversities into opportunities.

Modernization is a continuous process and can be part of Renovation Program


THANKS



400kV GIS at Nathpa Jhakri Substation
400kV - T155 Model GIS
400kV GIS-GAS SINGLE LINE DIAGRAM

GD34A000235 Rev. 03

NOTE :
SCOPE 1:
PANCHKULA-II (Ex ABDULLAPUR-II) CIRCUIT BREAKERS (B-142 MODEL) IS TO BE RETROFIT WITH T-155 CB MODULES
SCOPE 2:
FUTURE 1 BAY TO BE EXTENDED FROM THE EXISTING COMMON POINT ASSEMBLY TO SF6 TO AIR BUSHING TERMINATION

CURRENT TRANSFORMER
According to IEC 61869-2

Ith =50kA, 1s — Idyn =125kA — Icth =120%

CT No	Bay Name	Quantity (1 phase)	Alstom Ref	Core Identification	Ratio (A)	Accuracy class	Output (VA)	ISF	Min. KPV (Vk)	RCT (Ω) at 75deg C	Max. Exciting Current (mA) at Vk/4	Application
CT-1	BUS REACTOR	P2 03 NOS	N9	Core # 4	200 / 1	0.5	20	-	-	-	-	METERING
			F8	Core # 3	200 / 1	PS	-	-	200	1.5	<30	LBB, BACKUP IMPEDANCE
			F8	Core # 2	200 / 1	PS	-	-	200	1.5	<30	REACTOR REF PROTN
		P1	F8	Core # 1	200 / 1	PS	-	-	200	1.5	<30	REACTOR DIFF. PROTN
CT-2	BUS REACTOR	P1 03 NOS	F1	Core # 1	4000 / 1 2000 / 1 1000 / 1	PS PS PS	- - -	- - -	- - >500	- - <10	- - <30	BUSBAR DIFF.PROTN (MAIN ZONE)
		P2	F1	Core # 2	4000 / 1 2000 / 1 1000 / 1	PS PS PS	- - -	- - -	- - >500	- - <10	- - <30	BUSBAR DIFF.PROTN (CHECK ZONE)

MAIN CHARACTERISTICS

RATED CURRENT EXISTING BUSBAR	Ir	4000A
RATED CURRENT EXISTING BUSCOUPLER	Ir	4000A
RATED CURRENT LINE BAYS, REACTOR & ICT BAYS	Ir	2000A
RATED FREQUENCY	Fr	50Hz
SHORT-TIME WITHSTAND CURRENT	Ik	50kA
DURATION	tk	1s
RATED VOLTAGE	Ur	420 kV rms
POWER FREQUENCY WITHSTAND VOLTAGE	Ud	650 kV rms
LIGHTING IMPULSE WITHSTAND VOLTAGE	Up	1425 kVp
SWITCHING IMPULSE WITHSTAND VOLTAGE	Us	1050 kVp
PEAK WITHSTAND CURRENT	Ip	125kA
INTERNAL ARC WITHSTAND TIME		500 ms
MAXIMUM GAS LOSS PER YEAR		<0.5 %

LEGEND

Symbol	Description
(.....) Qxx	INTERNAL DESIGNATION CUSTOMER'S DESIGNATION
	CIRCUIT-BREAKER
	DISCONNECTOR
	BUSBAR
	CURRENT TRANSFORMER
	VOLTAGE TRANSFORMER
(ES)	INSULATED MAINTENANCE EARTHING SWITCH
(FES)	INSULATED FAST ACTING EARTHING SWITCH
	SF6-AIR BUSHING
	TELESCOPIC ENCLOSURE
▽	MODIFICATION
	GAS PARTITIONING
BAY-01	ALSTOM BAY NUMBERING
	GAS COMPONENTS : DENSITY SWITCH BURSTING DISC FILLING VALVE
(PDC)	PARTIAL DISCHARGE COUPLER

SF6 AIR BUSHING PARAMETER

Power Frequency Withstand Voltage	Ud	650 kVrms
Lightning Impulse Withstand Voltage	Up	1425 kVp
Minimum Creepage distance	mm/kV	25 mm/kV
Total Creepage Distance	mm	10500 mm

SF6 DENSITY MONITORING DETAILS

CIRCUIT BREAKER	OTHER COMPARTMENTS
Normal : 6.3 Bars SF6 Refill level : 6.0 Bars SF6 Alarm level : 5.7 Bars	Normal : 6.3 Bars SF6 Refill level : 5.8 Bars SF6 Alarm level : 5.5 Bars

Notes:
1. All Gas compartment are equipped with Gas Gas Density switch+Pressure gauge, Pressure Relief Device & Gasfilling Value.

LEGEND :

SYMBOL	DESCRIPTION
———	PRESENT SCOPE
– – – –	EXISTING SCOPE

GIS COLOR:
INDOOR : GRAY RAL 7038
OUTDOOR : GRAY RAL 9018

NOTE :
Rct Value for F8 Core to be confirmed