# TURBINE COMMISSIONING

# Turbine and auxiliaries

- Acid cleaning-oil lines
- Lube oil flushing and hydraulic test
- Jacking oil lines flushing and hydraulic test
- Detergent flushing and hydraulic test of regenerative system
- BFP commissioning

# Turbine and auxiliaries

- Commissioning of HP/LP heaters
- Barring gear operation
- Vacuum tightness test
- Steam blowing procedure
- Check list for first rolling of turbine

# ACID CLEANING

- Purpose?
- Steps
  - Mechanical cleaning and flange preparation
  - Acid cleaning
  - Passivation and drying
  - Final erection in position

# ACID CLEANING

- Mechanical cleaning and flange preparation
  - Chipping & grinding of protruding welds
  - Wire brushes pulling through pipes
  - Steel chains for smaller pipes
  - Blow compressed air
  - Ready for acid cleaning

# ACID CLEANING

- Acid cleaning
  - Looping of pipes of same diameter
  - Flush the loop with 15% Orthophosphoric acid at 30-40deg. For 2-3 hours
  - For strongly corroded pipes:3-4 hours flushing, pressurize at 0.5-1Ksc for 6-7 hours then again flush for 2-3 hours
  - Stainless steel mesh at the return line

# ACID CLEANING

- Passivation
  - Circulate 2% solution for 1-1.5 hours
  - Drain loop and dismantle for drying
  - Blow dry hot air for 30-40 min at 3-4 Ksc. At 50-60deg. For each pipe
  - Inspection: dark steel grey color-completion
  - Cover ends with new cloth / wooden blanks

# ACID CLEANING

- Final erection in position
  - Gasket inner bore> pipe diameter
  - No cutting / welding after cleaning
  - No jute for cleaning
  - Use electric bulb during inspection

# OIL FLUSHING & HYDRAULIC TEST OF TURBINE OIL SYSTEM

# TG LUB OIL & JACKING OIL SYSTEMS

- L.O SYSTEM
  - LUBRICATION
  - BARRING GEAR
  - HEAT DISSIPATION

- J.O SYSTEM
  - SHAFT LIFTING
  - PREVENT DRY FRICTION
  - OVERCOME BREAKING AWAY TORQUE DURING START UP ON HYDRAULIC TURNING GEAR

- ELEMENTS
  - AOP
  - JOP
  - MOP
  - INJECTORS
  - COOLERS
  - OIL TEMPERATURE CNTROL VALVE
  - DUPLEX FILTERS
  - OIL THROTTLES
  - HYDRAULIC TURNING GEAR
  - MOT
  - VAPOUR EXHAUSTER FANS
  - CENTRIFUGE
  - DIRTY OIL TANK
  - WASTE FLUID TANK

# TG LUB OIL & JACKING OIL SYSTEMS

## L.O.FLUSHING OBJECTIVE

- TO FLUSH COMPLETE TG L.O&J.O SYSTEMS WITH TURBINE OIL TO REMOVE MECHANICAL IMPURITIES

## ARRANGEMENTS FOR LUB OIL SYSTEM

- LO SYSTEM COMPLETE
- TEMPORARY PIPING CLEANED & INSTALLED
- THERMAL SHOCK SCHEME READY
- COT & DOT AVAILABLE
- FIRE FIGHTING SYSTEM

## MOT

- MOP SUCTION & DISCHARGE ARE LOOPED WITH ½" VENT VALVE(KEEP OPEN)
- BEARING PEDESTALS, MOT & STRAINER CLEANED MANUALLY & INSPECTED
- VAPOUR EXTRACTERS AVAILABLE & LINE VALVES KEPT OPEN
- AOP, JOP, CENTRIFUGE AVAILABLE
- MOT & ITS EVEL INDICATOR

## LO SYSTEM

- OIL THROTTLES FOR INJECTORS REPLACED WITH ADAPTERS
- TURNING GEAR NOZZLE BOX REPLACED WITH FLUSHING DEVICE
- L.O SUPPLY & RETURN HEADERS LOOPED AT BRG-7 END WITH VALVE
- BRG- 1TO 4 PROVIDED WITH FLUSHING DEVICES
- BRG- 5 TO 7 SUPPLY & RETURN LINES LOOPED
- THRUST BEARING PADS REMOVED

# TG LUB OIL & JACKING OIL SYSTEMS

- COOLERS ADJUSTED FOR MAXIMUM FLOW
- DUPLEX FILTER ELEMENTS TAKEN OUT
- ALL THROTTLES IN THE LO SUPPLY LINE TO BRGs ARE FULLY CLOSED
- MOP REMOVED , SUPPLY & DISCHARGE LINES LOOPED
- TEMPERATURE INDICATORS BEFORE & AFTER COOLER

## JACKING OIL SYSTEM ARRANGEMENTS

- A LOOP GIVEN FROM AOP DISCHARGE HEADER TO JOP DISCHARGE LINE WITH AN ISOLATING VALVE & JOP DISCONNECTED
- JACKING OIL SUPPLY HEADER LOOPED TO L.O RETURN HEADER AT BEARING#7 END WITH AN ISOLATING VALVE
- J.O LINE TO BEARINGS DISCONNECTED & KEPT OPEN TO DRAIN INSIDE BEARING PEDESTALS
- ALL NRVs IN THE PUMP DISCHARGE & SUPPLY LINE TO BRGs ARE REMOVED
- JACKING OIL PRV REMOVED & BLANKING GIVEN

## METHOD

## OIL FILLING

- OIL QUALITY TESTED
- 40 $M^3$ OIL FILLED INTO MOT THROUGH CENTRIFUGE

## LO SYSTEM FLUSHING

## STAGE-1

- OIL COOLERS BYPASSED,SUPPLY & RETURN HEADERS LOOPED & ALL OTHER LINES KEPT ISOLATED
- START EOP FOR LINE VENTING & LEAKAGES CKECKING
- AOP STARTED FOR LINE FLUSHING & CENTRIFUGE WAS KEPT IN SERVICE

# TG LUB OIL & JACKING OIL SYSTEMS

- INSPECT MOT STRAINERS FOR EVERY HOUR DURING INITIAL FLUSHING & THERE AFTER ONCE IN A DAY
- AFTER 2-3 DAYS COOLERS CAN BE NORMALISED
- HEAT THE OIL UP TO 70-75$^0$C WITH THERMAL SHOCK ARRANGEMENT
- START COOLING SO THAT OIL TEMP. BEFORE COOLER IS BRAUGHT DOWN BY ABOUT 35-40$^0$C
- REPEAT THERMAL SHOCKS WITH INTERMITTENT RAPPING OF OIL LINES
- COLLECT THE OIL SAMPLE AT CENTRIFUGE INLET& CHECK FOR M.I & MOISTURE
- IF COMPLETION CRITERIA IS MET , CLOSE THE SUPPLY&DRAIN HEADER LOOP VALVE

## STAGE-2

- SELECT 2-3 BEARING PEDESTALS AT A TIME
- THROTTLES ARE KEPT WIDE OPEN TO ENSURE MAX. FLOW IN THE RETURN LINES
- ENSURE THAT AOP SHOULD NOT GET OVERLOADED
- START FLUSHING & THERMAL SHOCKS
- DO FLUSHING FOR TURNING GEAR LINE TWICE IN A DAY
- COLLECT THE OIL SAMPLE AT CENTRIFUGE INLET& CHECK FOR M.I & MOISTURE
- IF COMPLETION CRITERIA IS MET , CLOSE THE THROTTLES & GO FOR NEXT SET OF BEARING PEDESTALS
- MOP SUCTION & DISCHARGE LINES FLUSHING TO BE CARRIED OUT, BY LOOPING THE SUCTION LINE NEAR INJECTOR IN MOT, TO DIRTY OIL CHAMBER

# TG LUB OIL & JACKING OIL SYSTEMS

## FINAL STAGE OF FLUSHING

- TAKE ALL THE CIRCUITS FOR FLUSHING & CONTINUE THERMAL SHOCKS
- IF MOT STRAINER REMAINS CLEAN FOR 24 HOURS, STOP FLUSHING & INTRODUCE DUPLEX FILTERS
- REMOVE OIL THROTTLES & PUT LINE FILTERS IN THEIR PLACE
- CONTINUE FLUSHING USING THERMAL SHOCKS TILL COMPLETION CRITERIA IS MET
- CLEAN DUPLEX FILTERS & LINE FILTERS REGULARLY IF REQUIRED

***NOTE: JACKING OIL SYSTEM FLUSHING IS SIMILAR TO THE LO FLUSHING***

## COMPLETION CRITERIA

- MECHANICAL IMPURITIES <100PPM
- MOISTURE CONTENT <100PPM
- BASKET STRAINER REMAIN CLEAN AFTER 24 hours
- DUPLEX FILTER ELEMENT SHOULD REQURE CLEANING AFTER 12 hours

# TG LUB OIL & JACKING OIL SYSTEMS

- TECHNICAL DETAILS

  OIL PUMPS

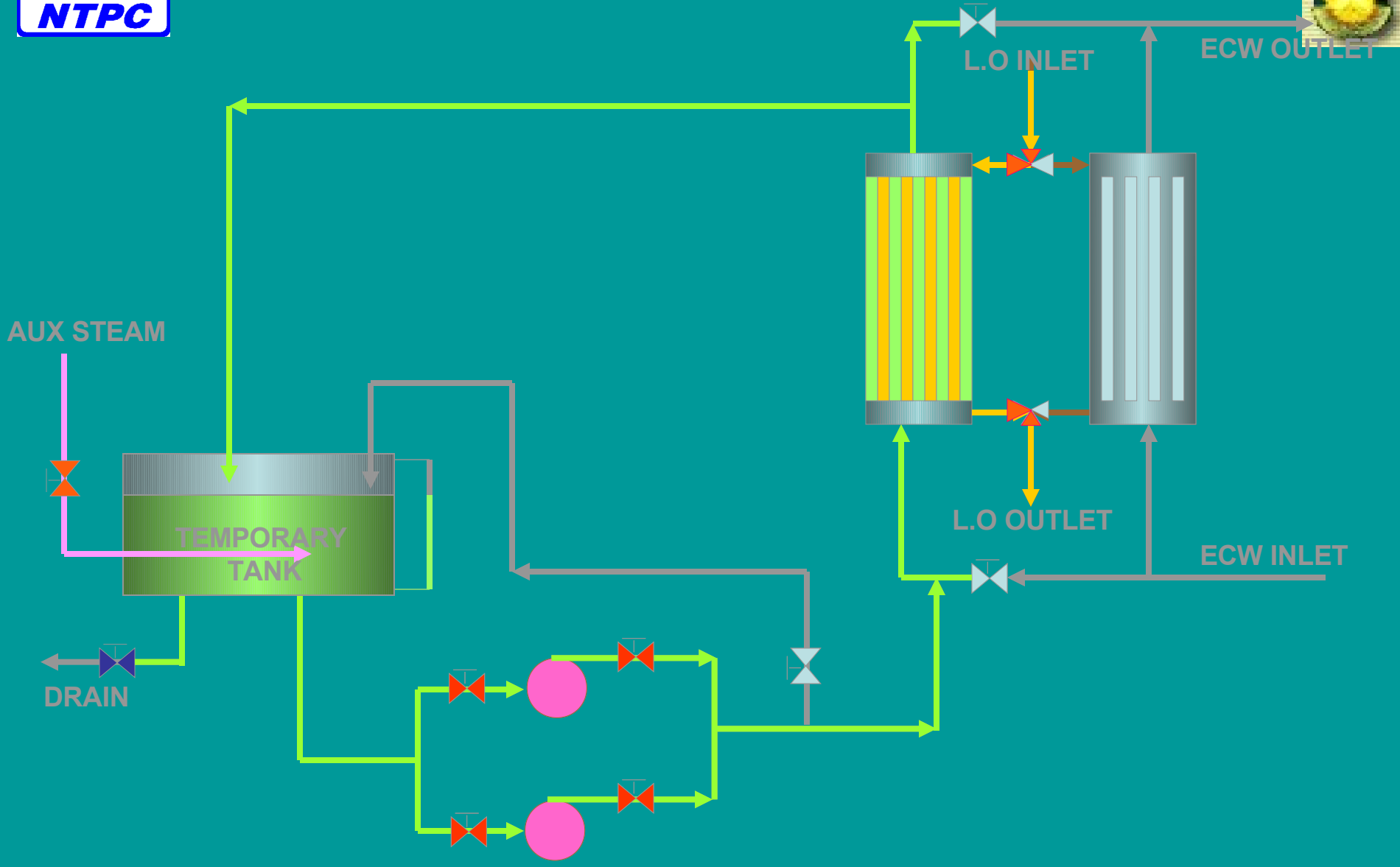
| | MOP | AOP | EOP | AC JOP | DC JOP |
|---|---|---|---|---|---|
| QUANTITY | 1 | 2 | 1 | 1 | 1 |
| MAKE | BHEL | MATHER-PLATT | MATHER-PLATT | ALLWEILER AG | ALLWEILER AG |
| TYPE | 350M³/Hr | 5/6 EHLH | 4/5 KL-70 | SDF/A80R4669-W112 | SDF/A80R4669-W112 |
| CAPACITY | 87.48dm³/s | 6016LPM | 1800LPM | 1.84 DM³/S | 1.84 DM³/S |
| DISCH.PR | 84M | 75.7M | 27.6M | 178 BAR | 178 BAR |
| SPEED(RPM) | 3000 | 2965 | 1425 | 2900 | 2900 |
| DRIVE | TURBINE | AC MOTOR | DC MOTOR | AC MOTOR | DC MOTOR |
| | | | | | |

# TG LUB OIL & JACKING OIL SYSTEMS

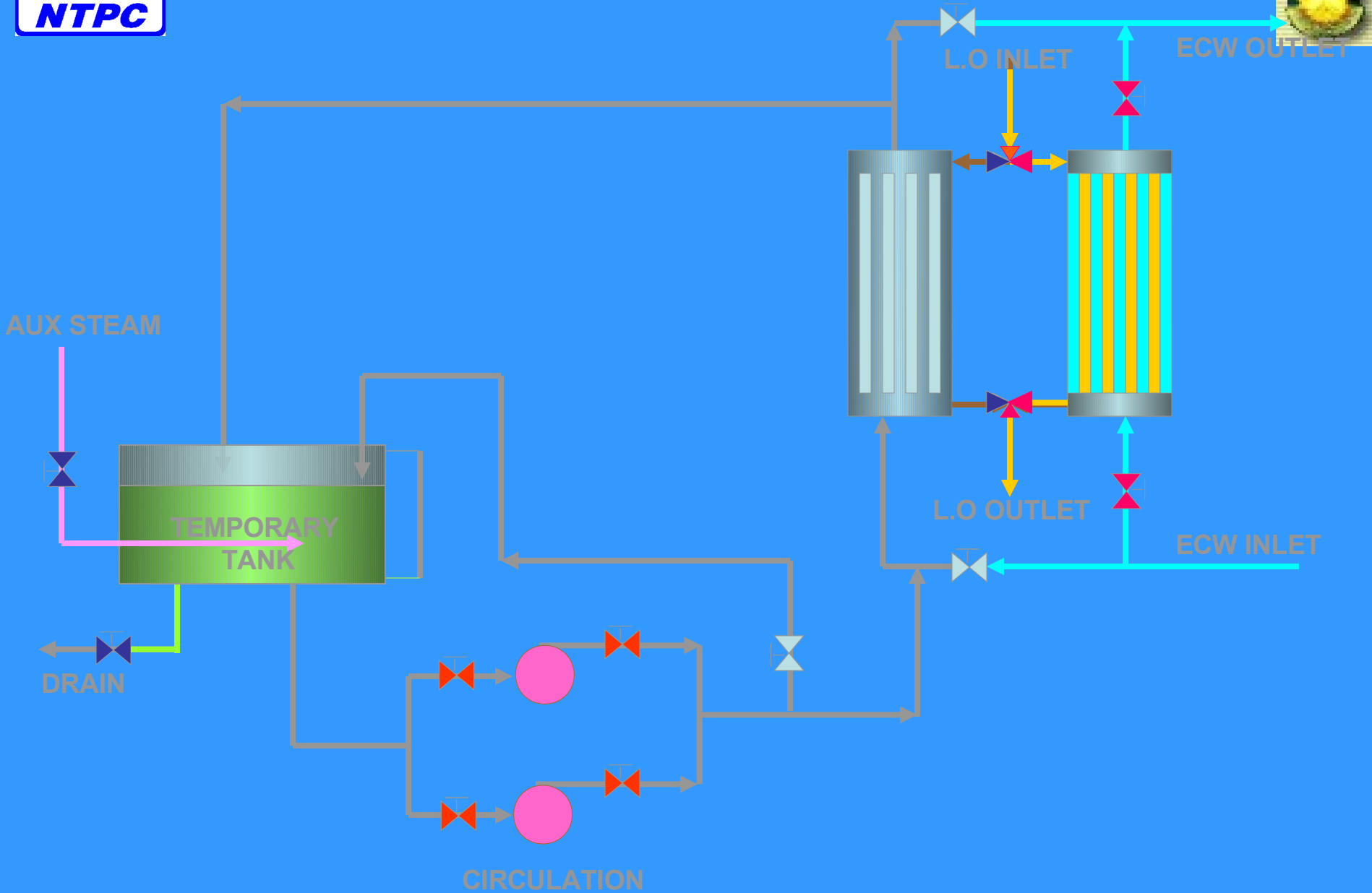
- **LUB OIL SECIFICATIONS**
  - **OIL OF VISCOSITY CLASS ISO VG 46 SHALL BE USED**
  - **CAPABLE OF WITHSTANDING BEARING TEMPERATURE OF MAX 130$^0$C**
  - **TOP UP THE OIL SHOULD BE OF SAME BRAND & QUALITY**
  - **CENTRIFUGING SHOULD BE FOR 40 HOURS, IF DIFFERENT OIL IS TOPPED**
  - **OIL SHOULD COMPLY THE REQUIREMENTS GIVEN IN THE TABLE, WHEN TESTED ACCORDING TO THE TEST METHOD GIVEN AGAINST THEM.**

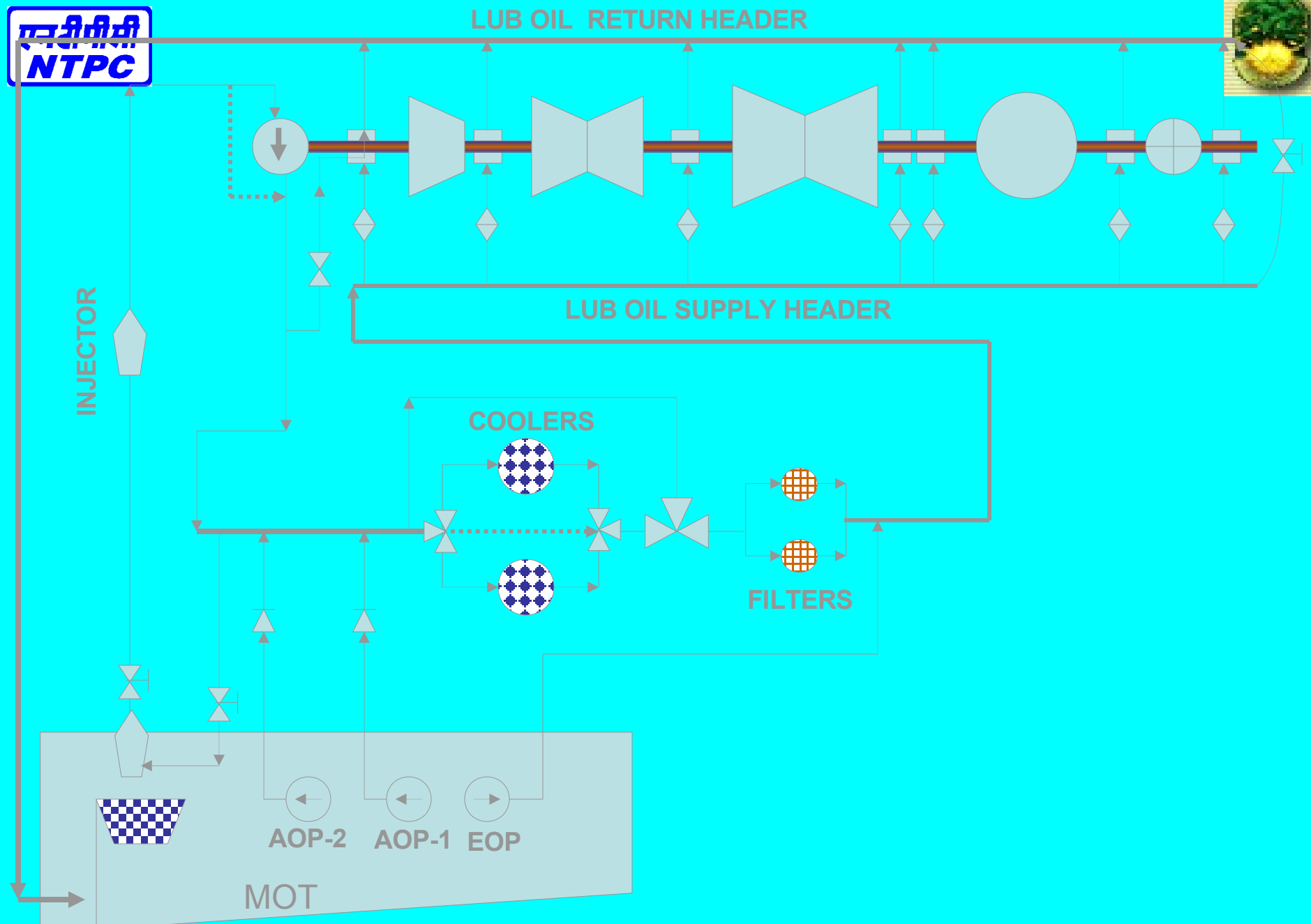
| L.O. SPECIFICATIONS | VALUE | TEST METHOD |
|---|---|---|
| KINEMATIC VISCOSITY | 41.4 TO 50.6 CST ( AT 40$^0$C)<br>28 CST ( AT 50$^0$C) | IS:1448 P-25 |
| VISCOSITY INDEX | MIN. 98 | IS:1448 P-56 |
| NEUTRALISATION NO. | MAX.0.2 mg of KOH PER gm of OIL | IS:1012 P-58 |
| SPECIFIC GRAVITY | 0.85 | IS:1448 P-32 |
| FLASH POINT | MIN 200$^0$C | IS:1448 P-59 |
| POUR POINT | -6$^0$C MAX. | IS:1448 P-10 |
| DEAERATION CAPACITY | 4MIN MAX. AT 50$^0$C | DIN:51381 |
| ASH % BY WEIGHT | MAX. 0.01 | IS:1448 P-4 |
| WATER % BY WEIGHT | MAX. 0.01 | ISO:3733 |
| SOLIDS % BY WEIGHT | MAX. 0.05 | DIN:51592 |
| FOAMING TENDENCY | MAX 400CM$^3$ | ASTM:D892 |
| FOAMING STABILITY | MAX 450S | ASTM:D892 |
| COPPER STRIP CORROSION | NOT WORSE THAN NO-1 | IS:1448 P-15 |
| TOTAL ACIDITY AFTER 1000 Hrs OF OXIDATION | MAX.0.2 mg of KOH PER gm of OIL | DIN:51587 |

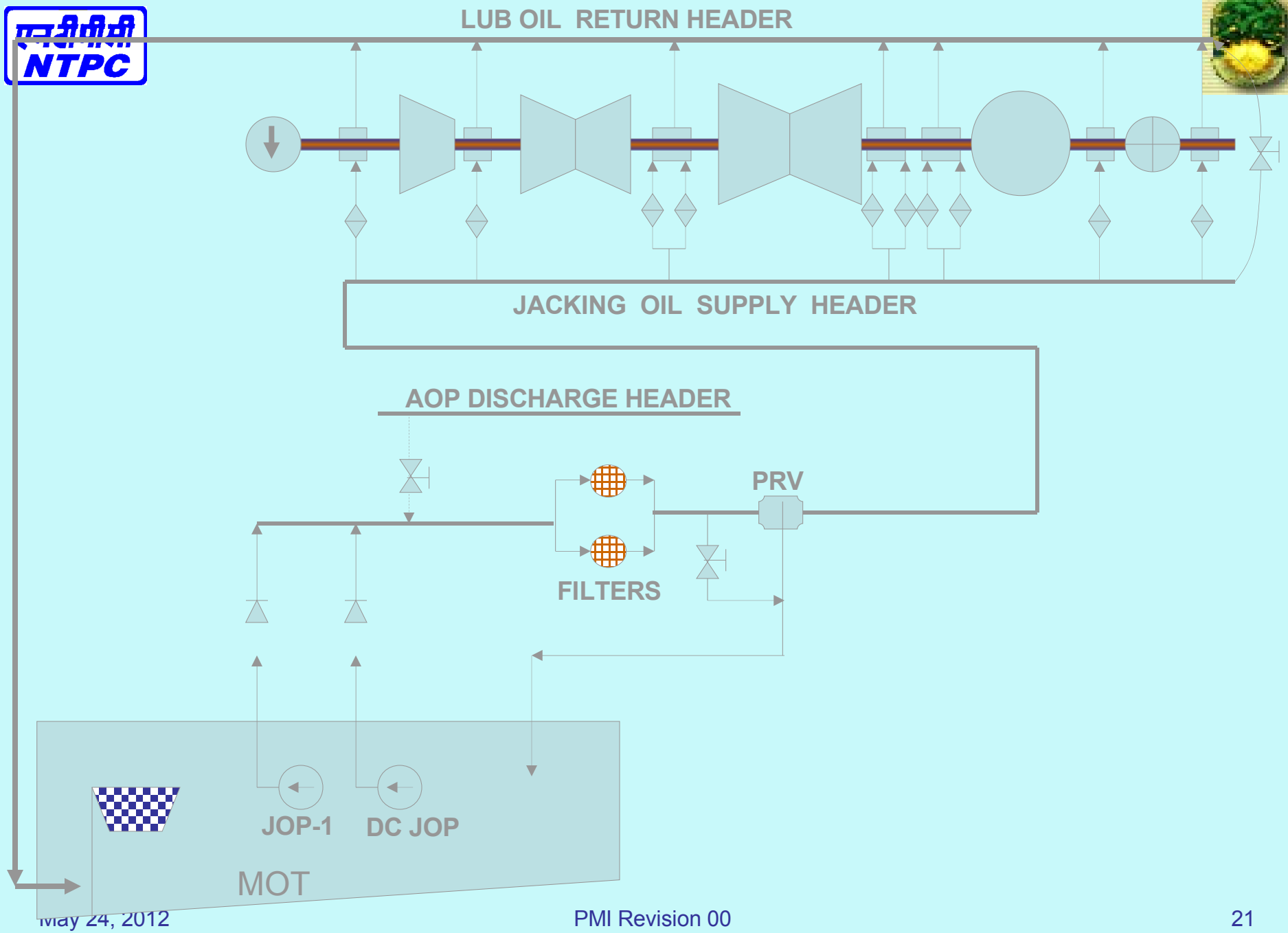
# LUB OIL HEATING ARRANGEMENT

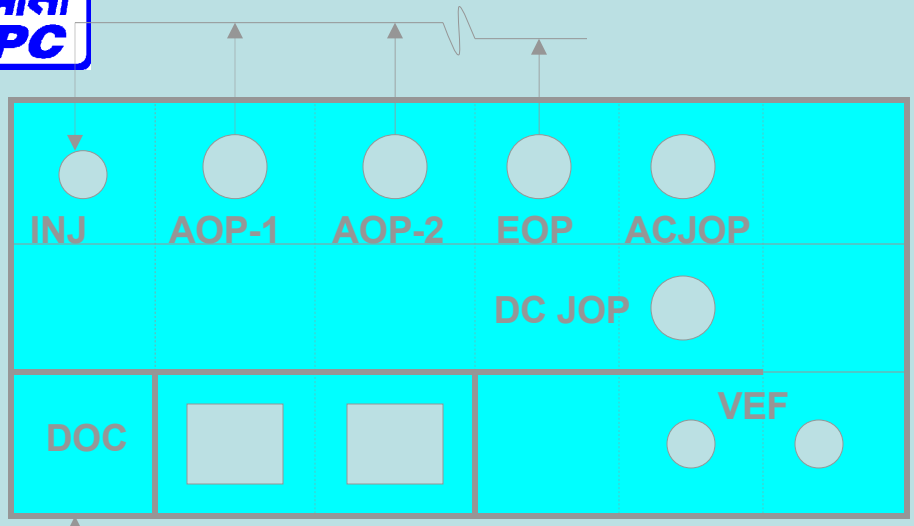


# LUB OIL COOLING ARRANGEMENT

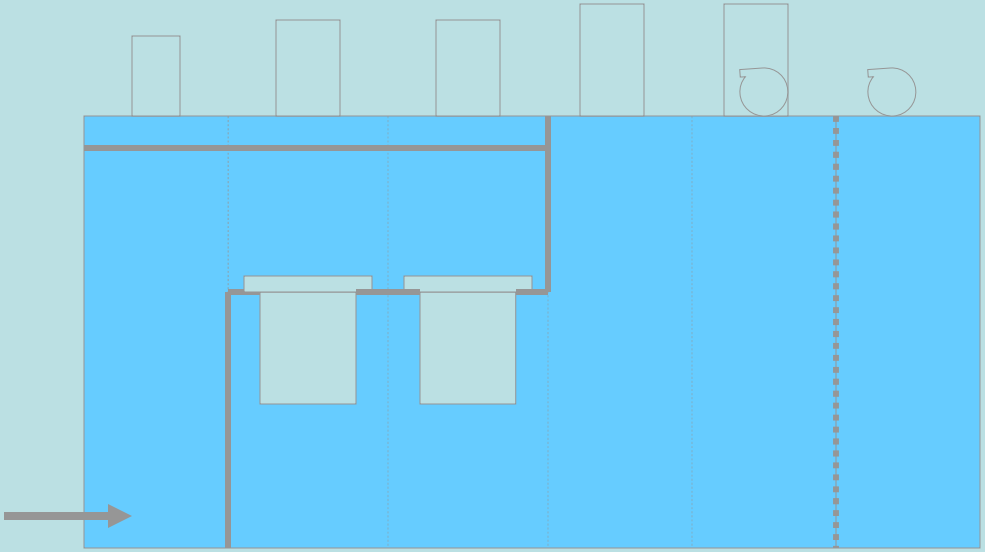



LUB OIL RETURN HEADER
LUB OIL SUPPLY HEADER
INJECTOR
COOLERS
FILTERS
AOP-2
AOP-1
EOP
MOT

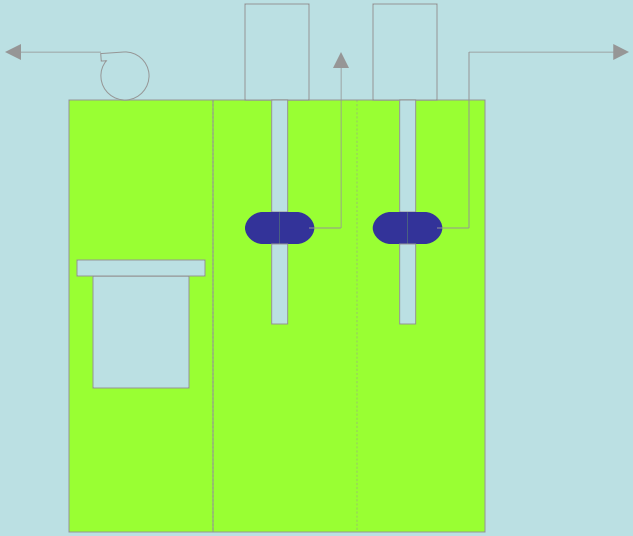

LUB OIL RETURN HEADER
JACKING OIL SUPPLY HEADER
AOP DISCHARGE HEADER
PRV
FILTERS
JOP-1
DC JOP
MOT



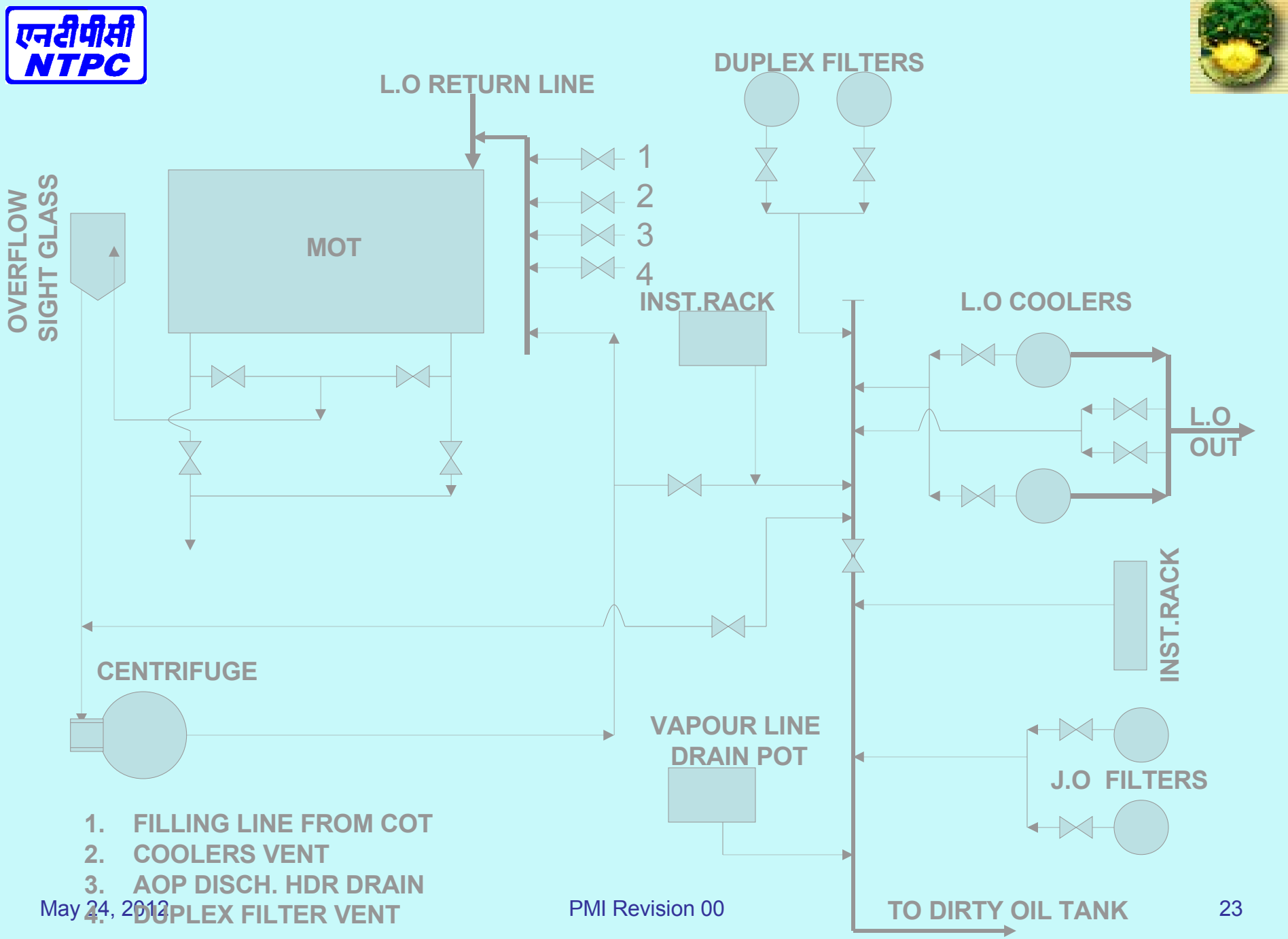

TOP VIEW




REAR VIEW



SIDE VIEW


L.O RETURN LINE
DUPLEX FILTERS
1
2
3
4
OVERFLOW SIGHT GLASS
MOT
INST.RACK
L.O COOLERS
L.O OUT
INST.RACK
CENTRIFUGE
VAPOUR LINE DRAIN POT
J.O FILTERS
1. FILLING LINE FROM COT
2. COOLERS VENT
3. AOP DISCH. HDR DRAIN
4. DUPLEX FILTER VENT
TO DIRTY OIL TANK

# Hydraulic test of oil lines

## HYDRAULIC TESTING OF LINES

### GENERAL

Hydraulic test of various lines shall be carried out as per chart given below.

| S.No | System / Item | Standard pressure | Test pressure | Duration |
|---|---|---|---|---|
| 1. | LUB OIL | 2.5 $kg/cm^2$ | 12 $kg/cm^2$ | 10 min |
| 2. | JACKING OIL | 120 $kg/cm^2$ | 180 $kg/cm^2$ | 10 min |
| 3. | OIL COOLER | 2.5 $kg/cm^2$ | 12 $kg/cm^2$ | 10 min |

NOTE: Oil Coolers are received at site after duly conducting hydraulic test at works (Test certificates are to be referred at site). Oil coolers are hydraulically tested at above parameters after concluding oil flushing.

# DETERGENT FLUSHING OF PRE BOILER SYSTEM

# DETERGENT FLUSHING OF PRE-BOILER SYSTEM

- PRE-BOILER SYSTEM CONSISTS OF
  - CONDENSATE SYSTEM
  - DRIP SYSTEM
  - FEED WATER SYSTEM
  - EXTRACTION STEAM LINES TO REGENERATIVE HEATERS

- **CONDENSATE SYSTEM**: COMPRISES OF 3 NO'S OF CEP'S, L.P.HEATERS, G.S.C, DRAIN COOLER, DEAERATOR, CONNECTING PIPELINES INCLUING EXCESS CONDENSATE LINE UPTO C.S.T.

- **FEED WATER SYSTEM**: COMPRISES OF 1 NO. MDBFP AND 2No's. TDBFP'S, THEIR BOOSTER PUMPS AND RECIRCULATION LINES , H.P HEATERS, THEIR CONNECTING PIPE LINES UPTO ECONOMISER INLET. RH & SH SRRAY LINES ARE ALSO INCLUDED FOR THE PURPOSE OF FLUSHING.

- **DRIP SYSTEM**: COMPRISES THE SHELL SIDE OF ALL LP &HP HEATERS & THE DRIP LINES.

- **EXTRACTION SYSTEM**: INCLUDES ALL EXTRACTION LINES TO LP & HP HEATERS

- ***OBJECTIVE:*** TO REMOVE DIRT, OIL, GREASE etc., FROM THE CONDENSATE , FEED WATER, DRIP & EXTRACTION STEAM LINES OF HP & LP HEATERS, USING A NON-IONIC DETERGENT ,PRIOR TO PUTTING THESE SYSTEMS IN REGULAR SERVICE.

- **THIS ENSURES FLOW OF CLEAN CONDENSATE & FEED WATER TO BOILER**

- **THE FOUR STAGES OF DETERGENT FLUSHING ARE:**
  - **STAGE-I: FEED LINES**
  - **STAGE-II: CONDENSATE LINES & DRIP LINES OF HPH-5A & 5B**
  - **STAGE-III: EXTRACTION STEAM LINES AND DRIP LINES OF HPHs**
  - **STAGE-IV: EXTRACTION STEAM LINES AND DRIP LINES OF LPHs**

- **NOTE: EACH SYSTEM SHALL BE SUITABLY SUBDIVIDED INTO VARIOUS SUB CIRCUITS TO COVER ALL THE LINES AND COMPONENTS**

# DETERGENT FLUSHING REQUIREMENTS

**1) CHEMICALS &WATER**

a) **DM WATER** : 5000T

**b) NON-IONIC DETERGENT**

- RINOPOL-JET 100% 1000 LITRES
- (OR SUMISOL-N 100% ) @0.05%CONCENTRATION

**c) FOR PASSIVATION**

- HYDRAZINE HYDRATE -800KG @ 80% CONCENTRATION (IS:12086/1991)
- LIQUOR AMMONIA------ 400KG @ 25% CONCENTRATION (IS:799/1985)

**2) PUMPS AND VALVES:**

**a) TEMPORARY CIRCULATION PUMPS ( 4Nos)** CAPACITY : 200T/hr
Head: 20 KG/CM$^2$
MOTOR : 180 KW

**b) TEMPORARY MIXING TANK CAPACITY 40 M$^3$ .**

**c) VALVES & INSTRUMENTS**

| | | |
|---|---|---|
| a) | STEAM SUPPLY LINE V/V (1No.) | 3" |
| b) | DM WATER SUPPLY LINE V/V (1No.) | 4" |
| c) | MIXING TANK DRAIN TO NEUTRALISATION PIT V/V (1No.) | 4" |
| d) | PUMP DISCHARGE SAMLE LINE V/V (1No.) | 1" |
| e) | DETERGENT RETURN SAMPLE LINE V/V (1No.) | 1" |
| f) | PUMP DISCHARGE LINE DRAIN V/V (1No.) | 1" |
| g) | DETERGENT RETURN LINE DRAIN V/V (1No.) | 10" |

# DETERGENT FLUSHING REQUIREMENTS

h) TEMPORARY P/P SUCTION LINE V/Vs (4Nos)
i) TEMPORARY P/P DISCHARGE LINE V/Vs (4Nos)
j) PUMPS RECIRCULATION V/V (1No.)
k) PUMPS COMMON DISCHARGE LINE V/V (1No.)
l) PRESSURE GAUGES (0-40Ksc) (2Nos)
m) TEMPERATURE GAUGES (0-150$^0$C) (2Nos)
n) LEVEL INDICATOR FOR MIXING TANK (2Nos)

**3) OTHER REQUIREMENTS**

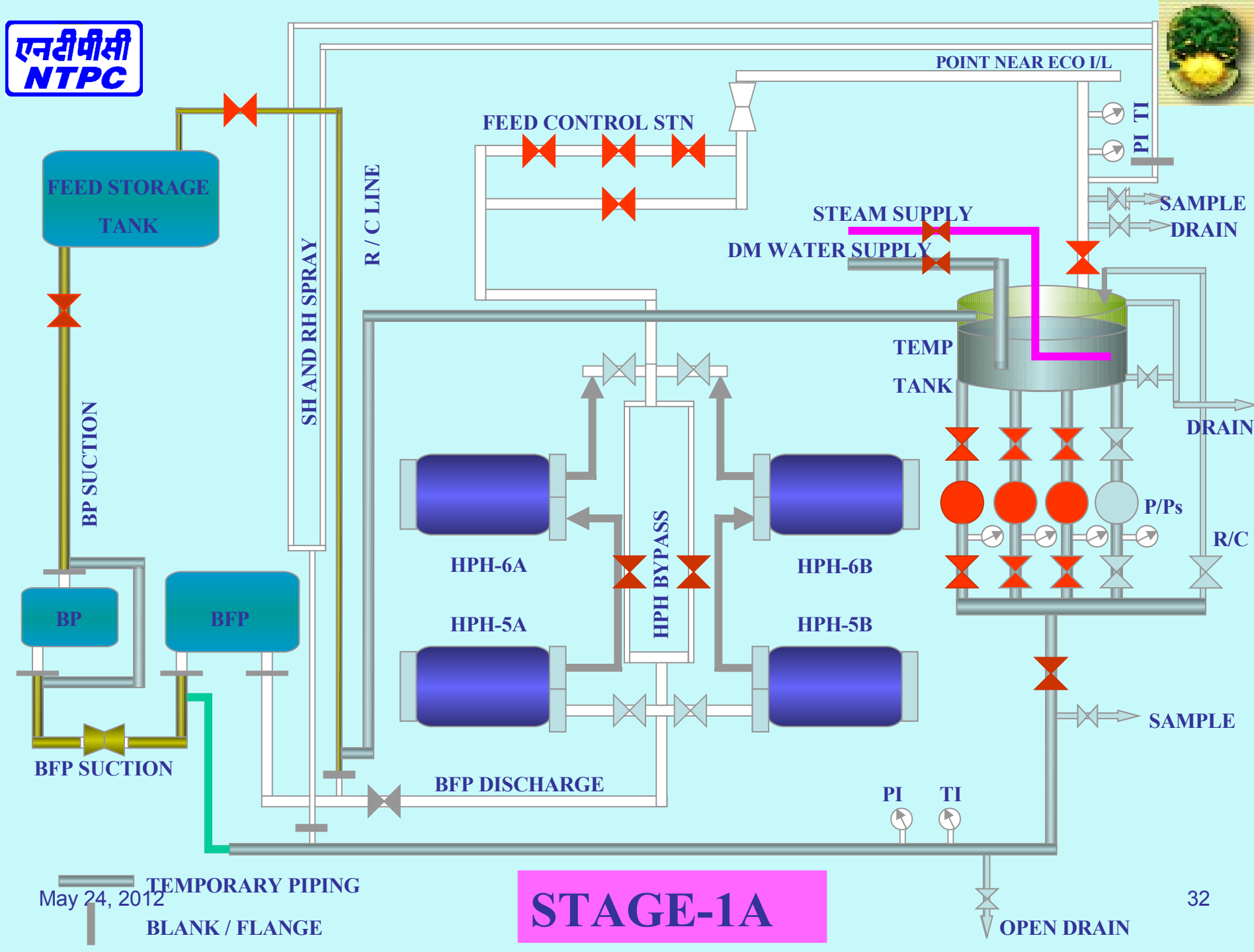
a) POWER SUPPLY TO TEMPORARY CIRCULATION PUMPS(415V)
b) ADEQUATE LIGHTING IN ALL WORKING AREAS
c) LABORATORY FACILITY FOR ANALYSIS OF FLUSHING WATER
d) SERVICE WATER
e) FIRE EXTINGUISHERS
f) ADEQUATE TEMPORARY PIPING & SUPPORTS

# METHOD

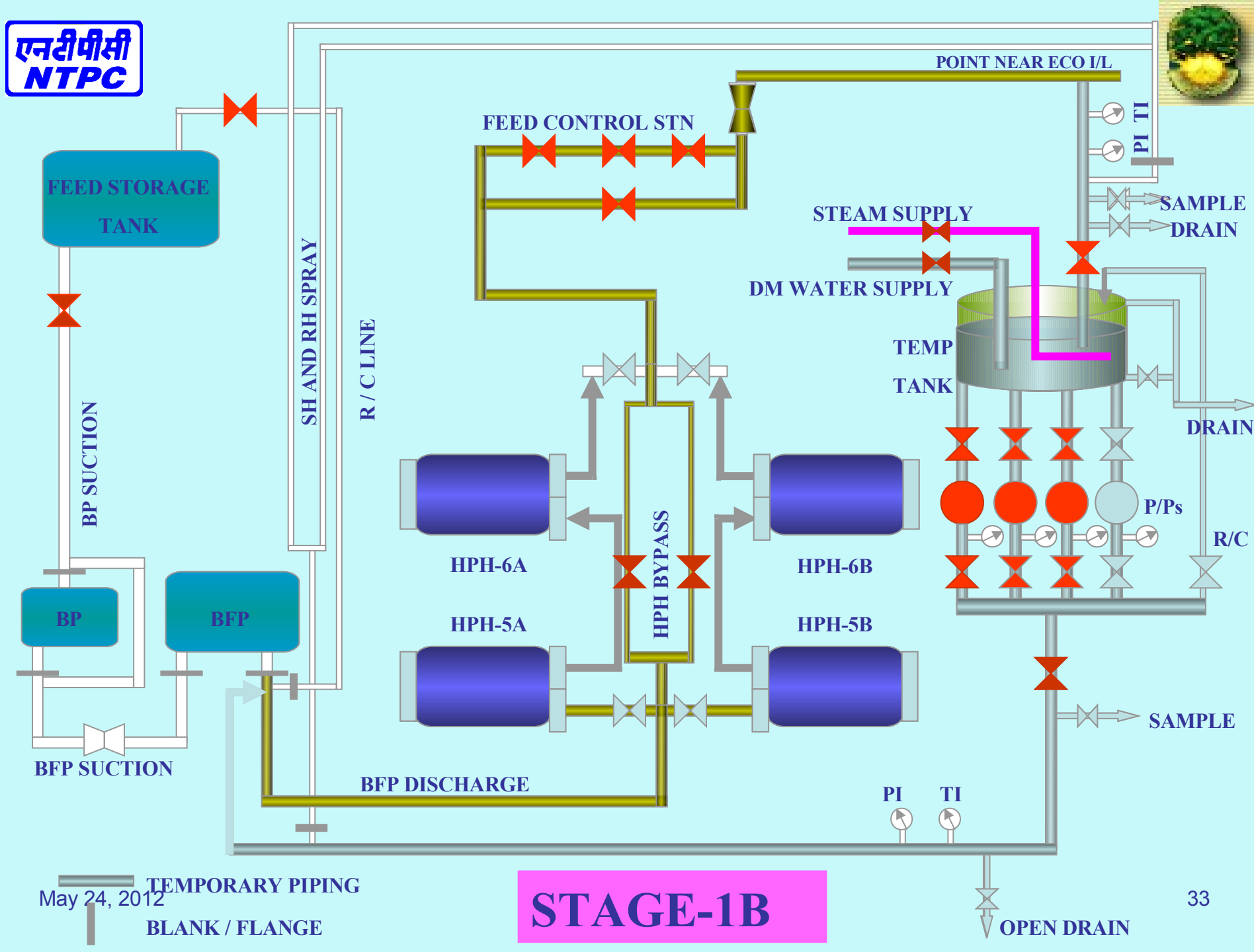
- LINE UP THE STAGE TO BE FLUSHED
- FILL THE SYSTEM WITH DM WATER BY CIRCULATION PUMPS
- CARRY OUT COLD WATER MASS FLUSHING IN ALL THE SUB LOOPS FOR 1 HOUR, AS EXPLAINED IN THE FOLLOWING SLIDES
- ADMIT STEAM INTO MIXING TANK & RAISE THE DM WATER TEMP. UP TO $60^0$C AND CARRY OUT HOT WATER MASS FLUSHING IN ALL THE SUB LOOPS FOR 1 HOUR
- STOP THE PUMPS AND DRAIN THE SYSTEM
- REFILL TOTAL SYSTEM WITH DM WATER BY RUNNING CIRCULATION PUMPS & ESTABLISH CIRCULATION
- ADMIT STEAM INTO MIXING TANK, RAISE THE WATER TEMP. TO $60^0$C ADD RINOPOL-JET 100% OR SUMISOL-N 100% TO ACHIEVE SOLUTION CONCENTRATION OF 0.05%
- CIRCULATE THE SOLUTION IN EACH OF THE LOOPS FOR A MIN. DURATION OF 4 HOURS. DURING CIRCULATION GIVE MAKE UP KEEPING THE SOLUTION TEMP.AT $60^0$C
- ON COMPLETION OF DETERGENT FLUSHING CARRY OUT CONTINUOUS MAKE UP AND DRAINING IN ALL LOOPS FOR 15 MIN.

# METHOD

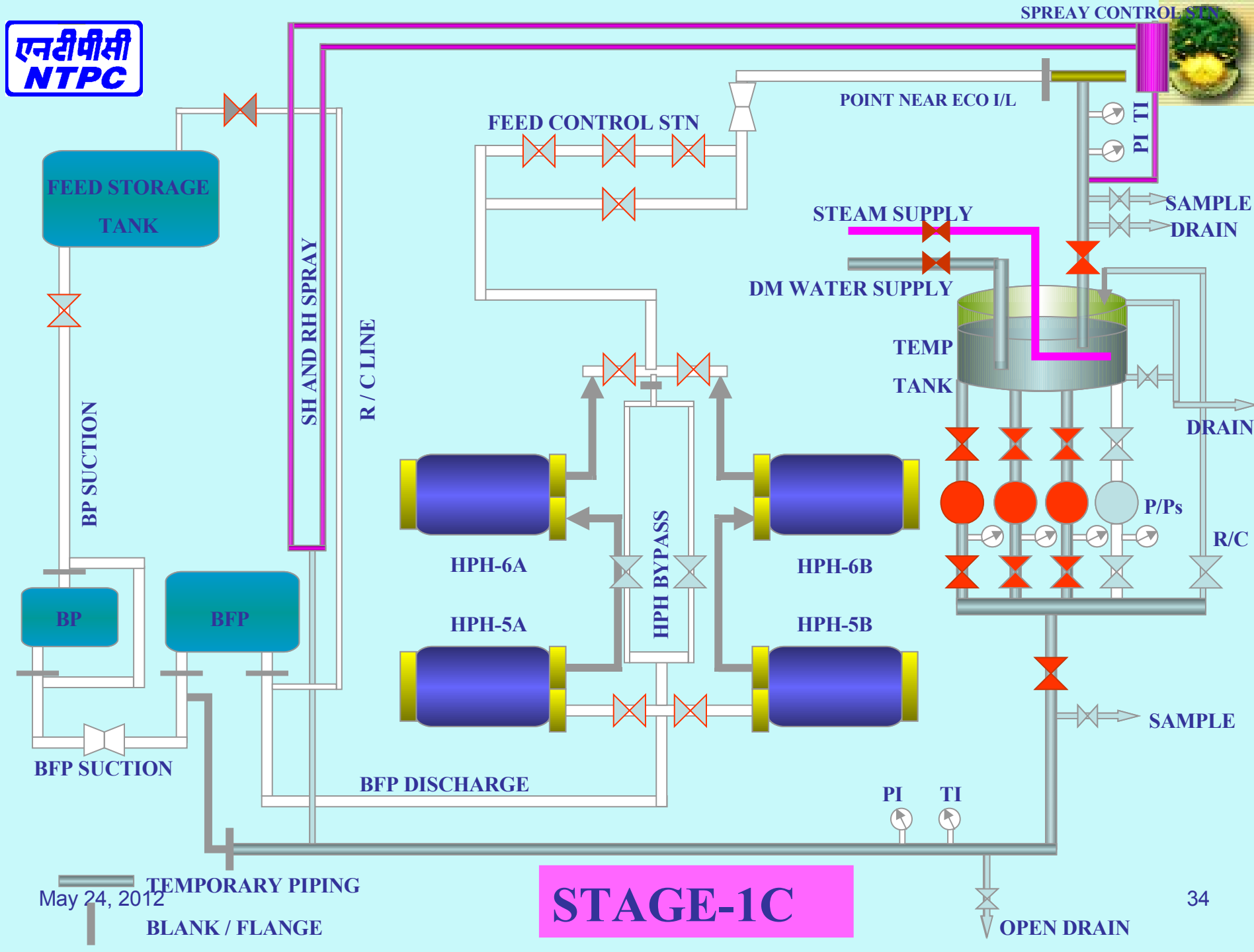
- ❖DRAIN THE SYSTEM COMPLETELY & FILL IT AGAIN WITH DM WATER
- ❖CIRCULATE DM WATER IN EACH LOOP FOR ½ HOUR ONCE AGAIN
- ❖DRAIN THE SYSTEM COMPLETELY
- ❖RINSE THE SYSTEM WITH DM WATER BY CONTINUOUS FILLING & DRAINING TO MEET COMPLETION CRITERIA
- ❖STOP THE PUMPS & DRAIN THE WHOLE SYSTEM
- ❖FILL THE SYSTEM WITH DM WATER & RAISE THE TEMP. TO $60^0$C
- ❖ADD HYDRAZINE & AMMONIA TO GET 200PPM HYDRAZINE& $P^H$ OF WATER TO 9.5 TO 10.0. RAISE THE TEMP. TO $80^0$C & MAINTAIN CIRCULATION FOR 8 HOURS
- ❖THEN DRAIN OUT THE SYSTEM & ALL AIR VENTS & FEED STORAGE TANK MAN HOLES ARE OPENED TO AERATE THE SYSTEM
- ❖MAKE INTERNAL INSPECTION OF D/A FOR FOREIGN MATERIAL, IF ANY, AND CLEAN THORUOGHLY
- ❖COMPLETION CRITERIA:DM WATER RINSING AFTER CHEMICAL FLUSHING SHALL BE CONSIDERED COMPLETE ONCE CONDUCTIVITY OF DRAINED WATER IS LESS THAN 10MICRO MHOS/ CM & OIL CONTENT IS NIL.


एनटीपीसी
NTPC
POINT NEAR ECO I/L
PI
TI
FEED CONTROL STN
FEED STORAGE TANK
R / C LINE
SH AND RH SPRAY
STEAM SUPPLY
DM WATER SUPPLY
SAMPLE
DRAIN
TEMP
TANK
DRAIN
BP SUCTION
HPH-6A
HPH-6B
HPH BYPASS
P/Ps
R/C
HPH-5A
HPH-5B
BP
BFP
SAMPLE
BFP SUCTION
BFP DISCHARGE
PI
TI
TEMPORARY PIPING
BLANK / FLANGE
OPEN DRAIN

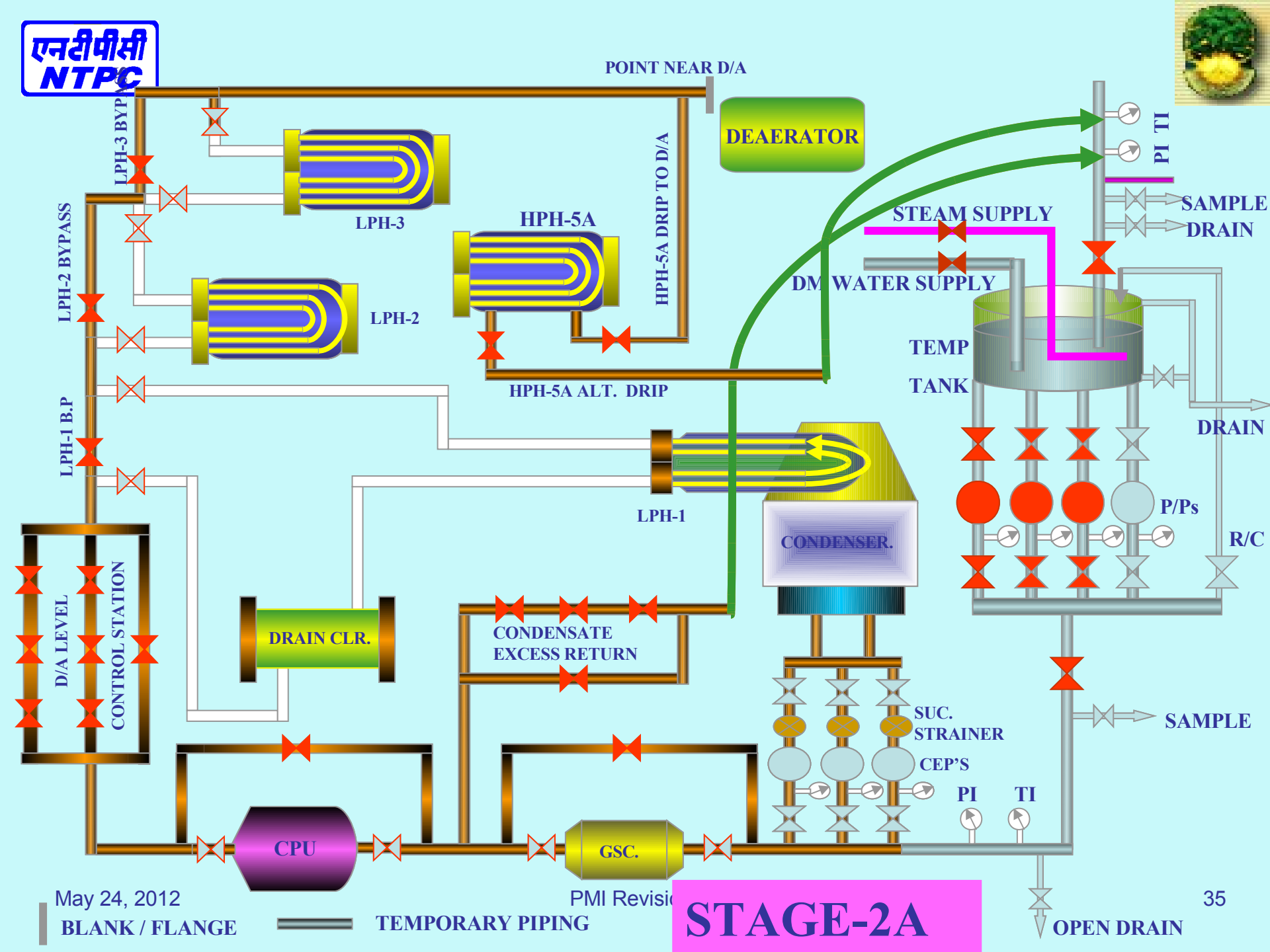
# STAGE-1A


POINT NEAR ECO I/L
FEED CONTROL STN
PI TI
SAMPLE
DRAIN
STEAM SUPPLY
DM WATER SUPPLY
FEED STORAGE TANK
SH AND RH SPRAY
R / C LINE
TEMP
TANK
DRAIN
BP SUCTION
HPH-6A
HPH-6B
HPH BYPASS
P/Ps
R/C
BP
BFP
HPH-5A
HPH-5B
SAMPLE
BFP SUCTION
BFP DISCHARGE
PI
TI
TEMPORARY PIPING
BLANK / FLANGE
OPEN DRAIN

# STAGE-1B


SPREAY CONTROL STN
POINT NEAR ECO I/L
FEED CONTROL STN
PI
TI
SAMPLE
DRAIN
STEAM SUPPLY
DM WATER SUPPLY
FEED STORAGE TANK
SH AND RH SPRAY
R / C LINE
TEMP
TANK
DRAIN
BP SUCTION
HPH-6A
HPH BYPASS
HPH-6B
P/Ps
R/C
BP
BFP
HPH-5A
HPH-5B
SAMPLE
BFP SUCTION
BFP DISCHARGE
PI
TI
TEMPORARY PIPING
BLANK / FLANGE
OPEN DRAIN

# STAGE-1C

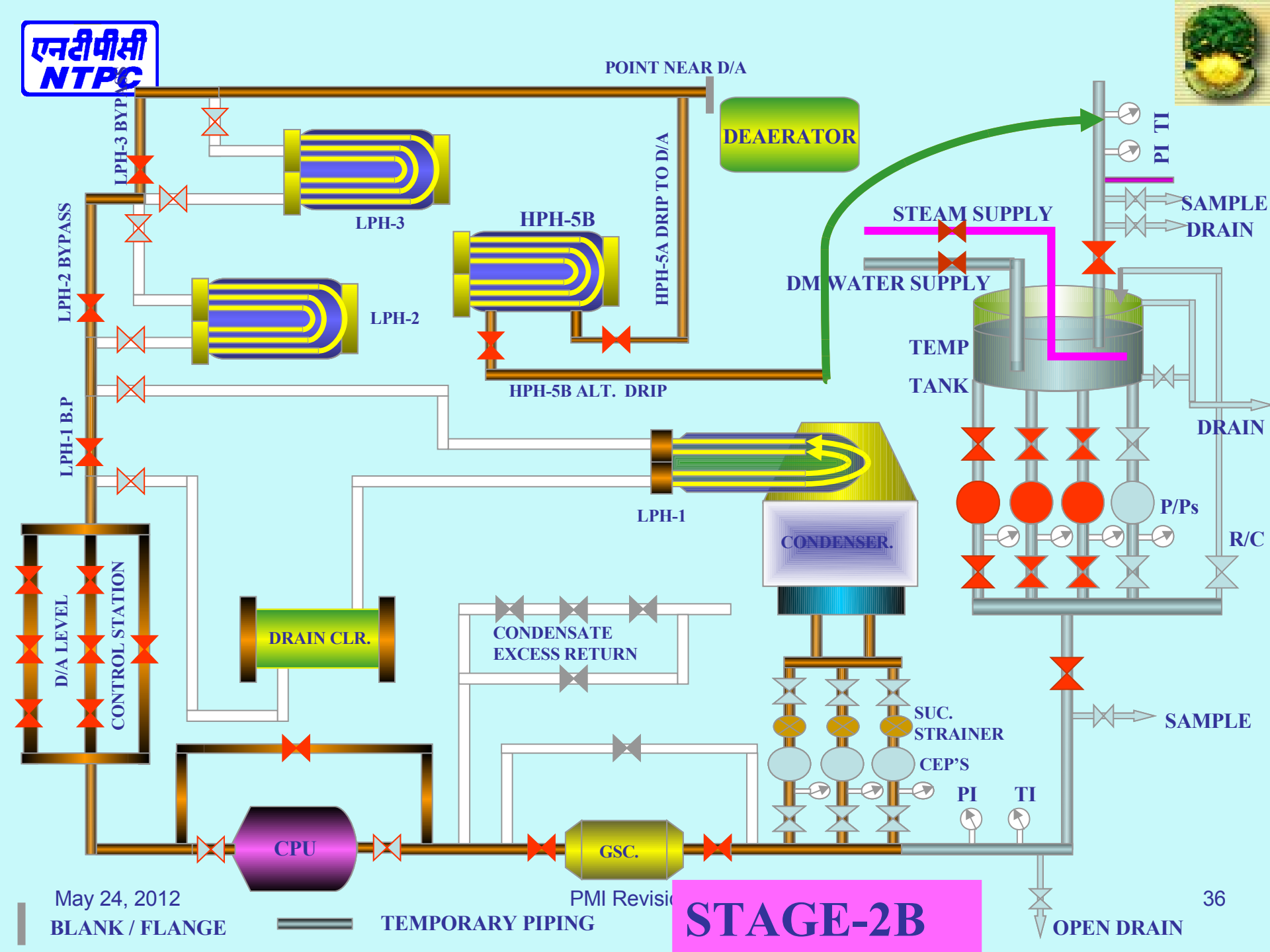





BLANK / FLANGE

TEMPORARY PIPING

STAGE-2A

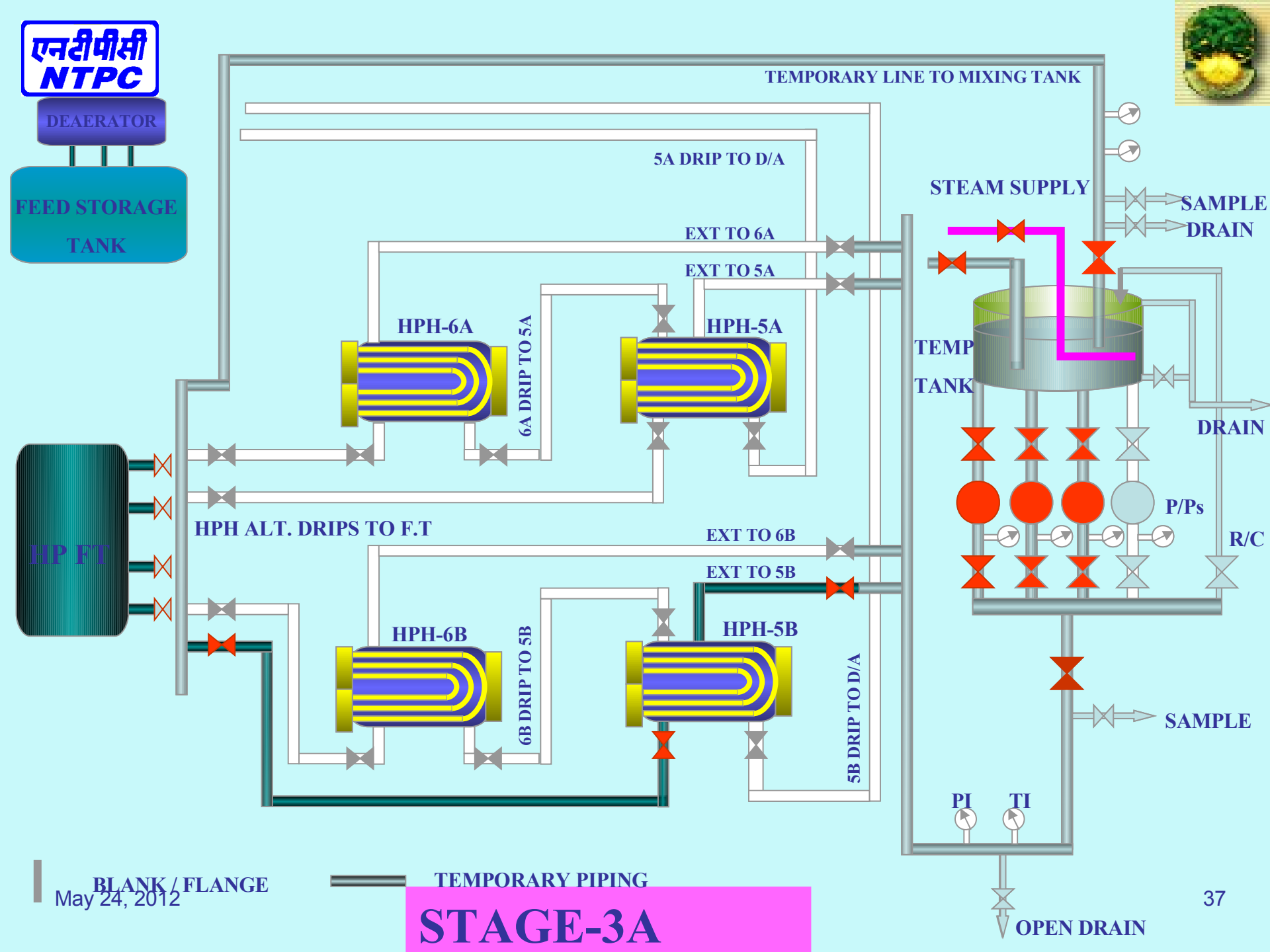




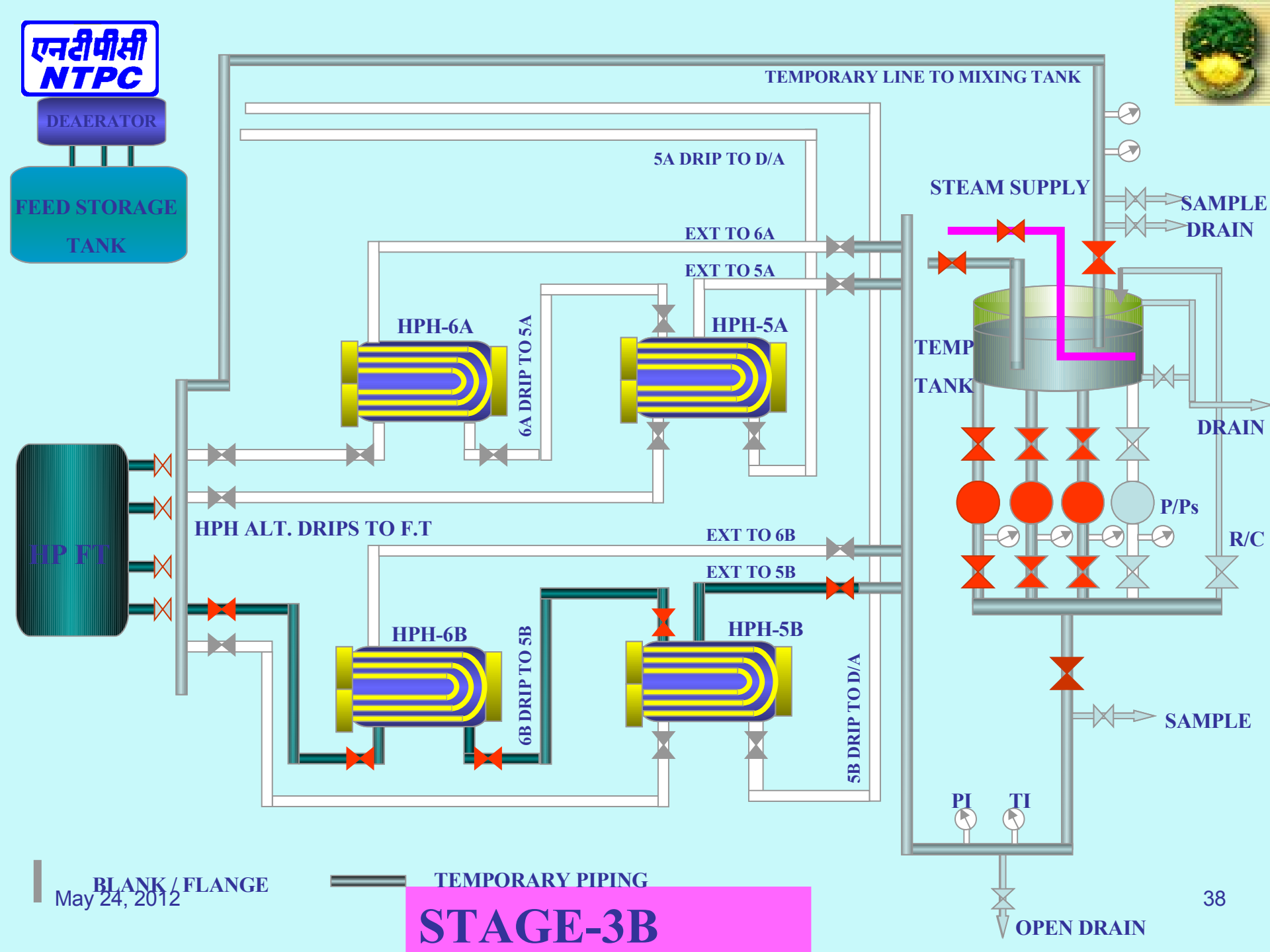

BLANK / FLANGE

TEMPORARY PIPING

STAGE-2B


DEAERATOR
FEED STORAGE TANK
TEMPORARY LINE TO MIXING TANK
5A DRIP TO D/A
STEAM SUPPLY
SAMPLE
DRAIN
EXT TO 6A
EXT TO 5A
HPH-6A
6A DRIP TO 5A
HPH-5A
TEMP TANK
DRAIN
HP FT
HPH ALT. DRIPS TO F.T
P/Ps
R/C
EXT TO 6B
EXT TO 5B
HPH-6B
6B DRIP TO 5B
HPH-5B
5B DRIP TO D/A
SAMPLE
PI
TI
BLANK / FLANGE
TEMPORARY PIPING
OPEN DRAIN

# STAGE-3A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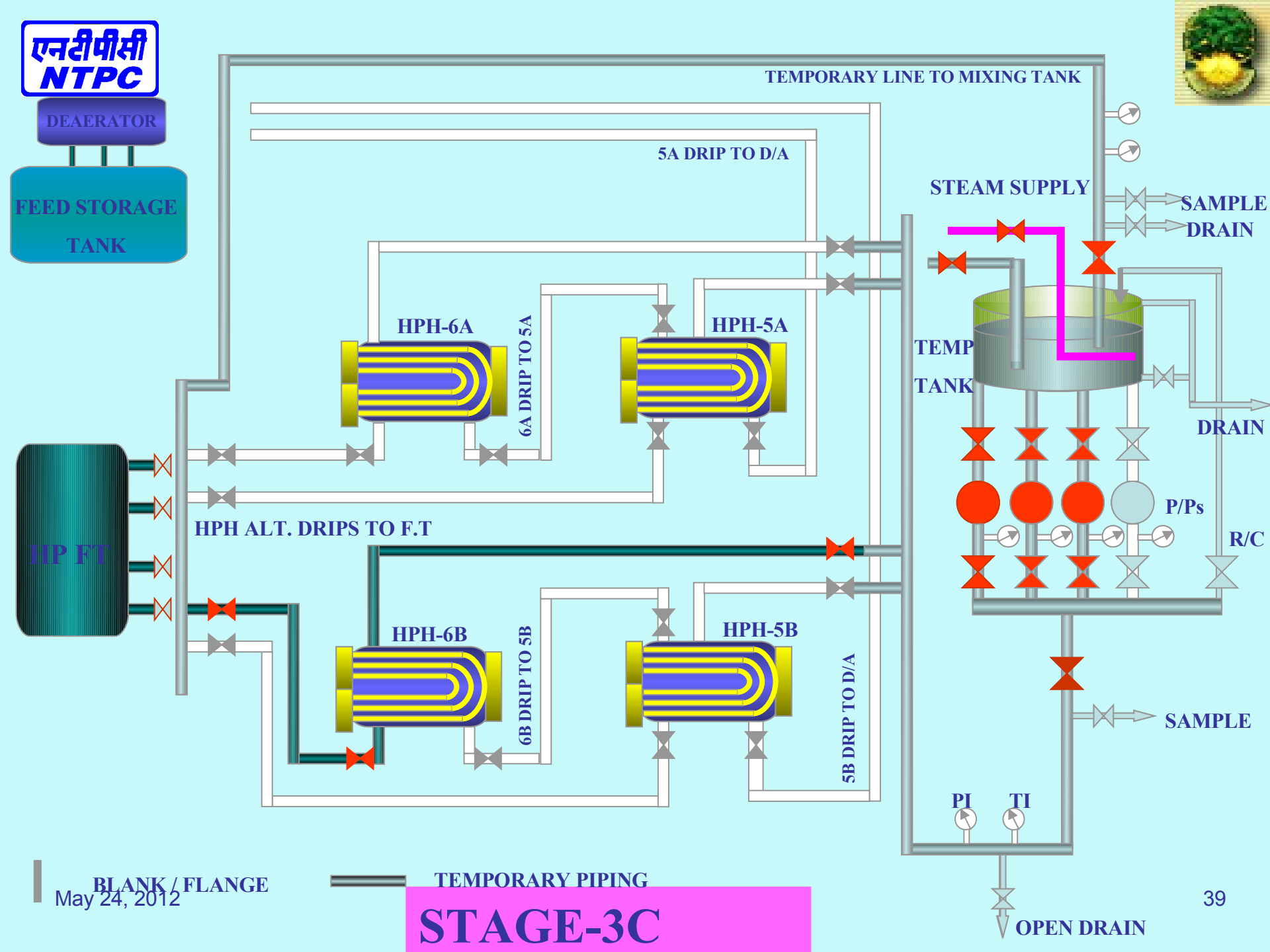
FEED STORAGE TANK
TEMPORARY LINE TO MIXING TANK
5A DRIP TO D/A
STEAM SUPPLY
SAMPLE
DRAIN
EXT TO 6A
EXT TO 5A
HPH-6A
6A DRIP TO 5A
HPH-5A
TEMP TANK
DRAIN
HP FT
HPH ALT. DRIPS TO F.T
P/Ps
R/C
EXT TO 6B
EXT TO 5B
HPH-6B
6B DRIP TO 5B
HPH-5B
5B DRIP TO D/A
SAMPLE
PI
TI
BLANK / FLANGE
TEMPORARY PIPING
OPEN DRAIN

# STAGE-3B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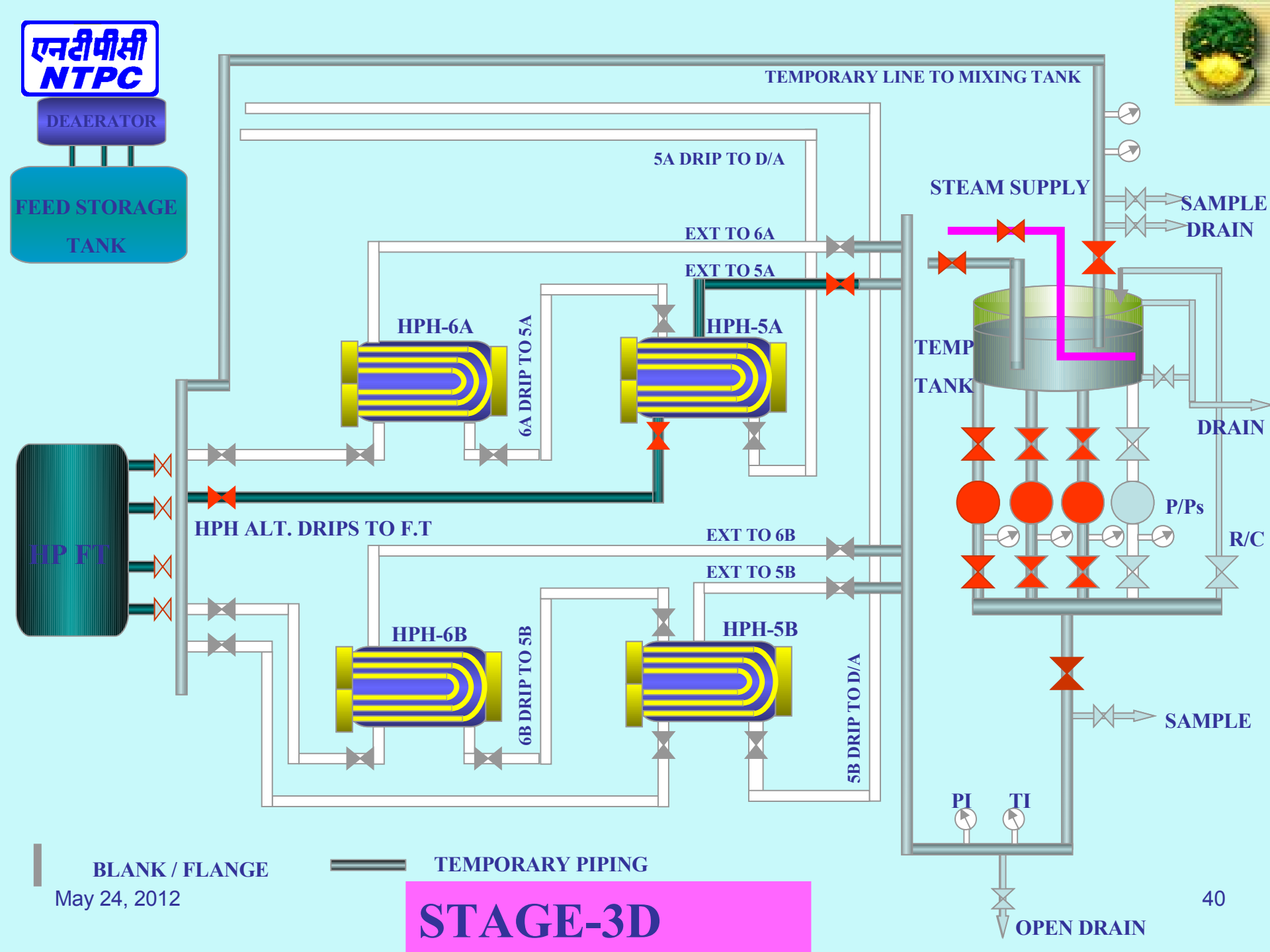
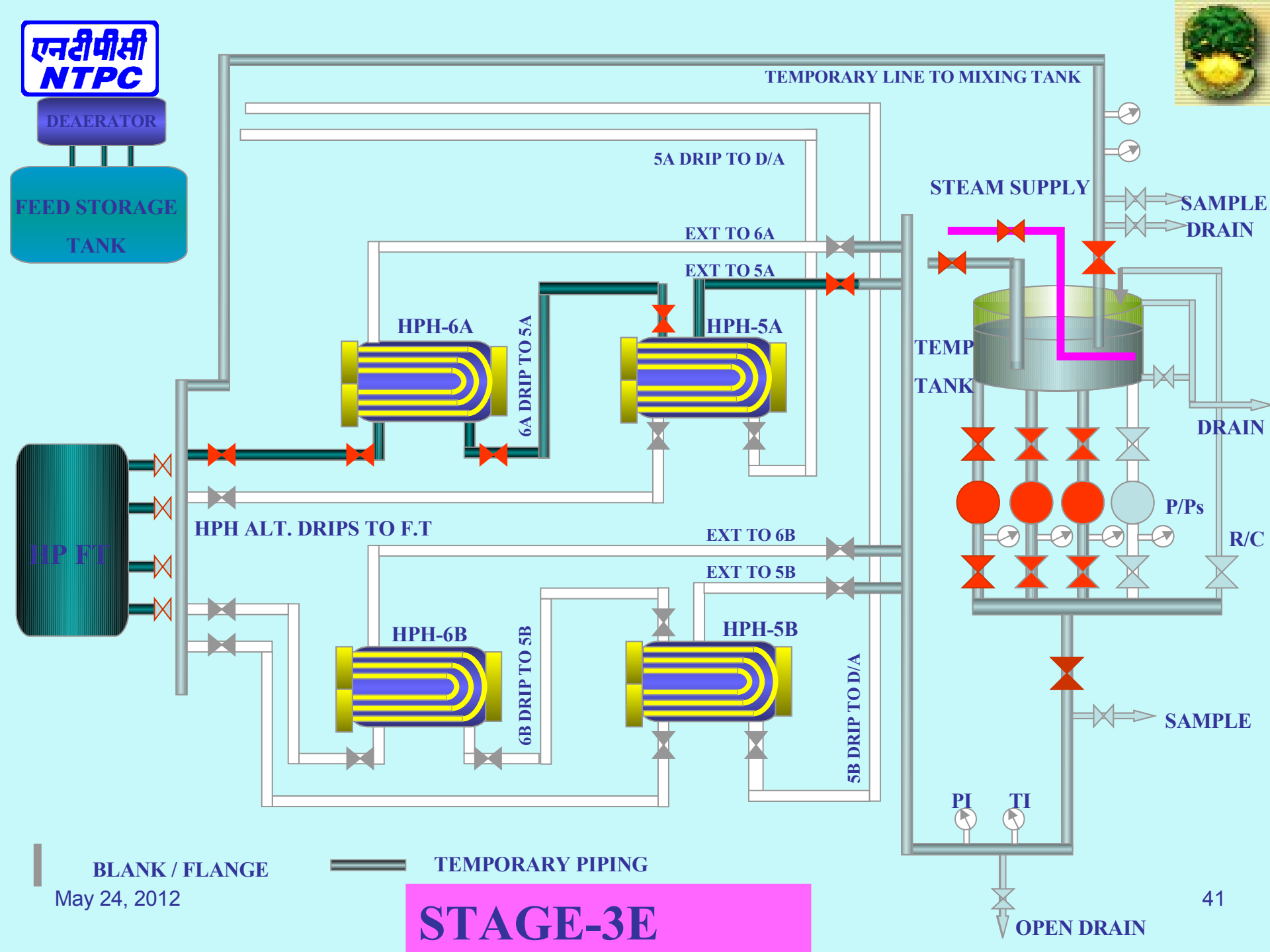
DEAERATOR
FEED STORAGE TANK
5A DRIP TO D/A
STEAM SUPPLY
SAMPLE
DRAIN
HPH-6A
6A DRIP TO 5A
HPH-5A
TEMP TANK
DRAIN
HP FT
HPH ALT. DRIPS TO F.T
P/Ps
R/C
HPH-6B
6B DRIP TO 5B
HPH-5B
5B DRIP TO D/A
SAMPLE
PI
TI
BLANK / FLANGE
TEMPORARY PIPING
OPEN DRAIN

# STAGE-3C


एनटीपीसी
NTPC
DEAERATOR
FEED STORAGE TANK
TEMPORARY LINE TO MIXING TANK
5A DRIP TO D/A
STEAM SUPPLY
SAMPLE
DRAIN
EXT TO 6A
EXT TO 5A
HPH-6A
6A DRIP TO 5A
HPH-5A
TEMP
TANK
DRAIN
HP FT
HPH ALT. DRIPS TO F.T
P/Ps
R/C
EXT TO 6B
EXT TO 5B
HPH-6B
6B DRIP TO 5B
HPH-5B
5B DRIP TO D/A
SAMPLE
PI
TI
BLANK / FLANGE
TEMPORARY PIPING
OPEN DRAIN



# STAGE-3D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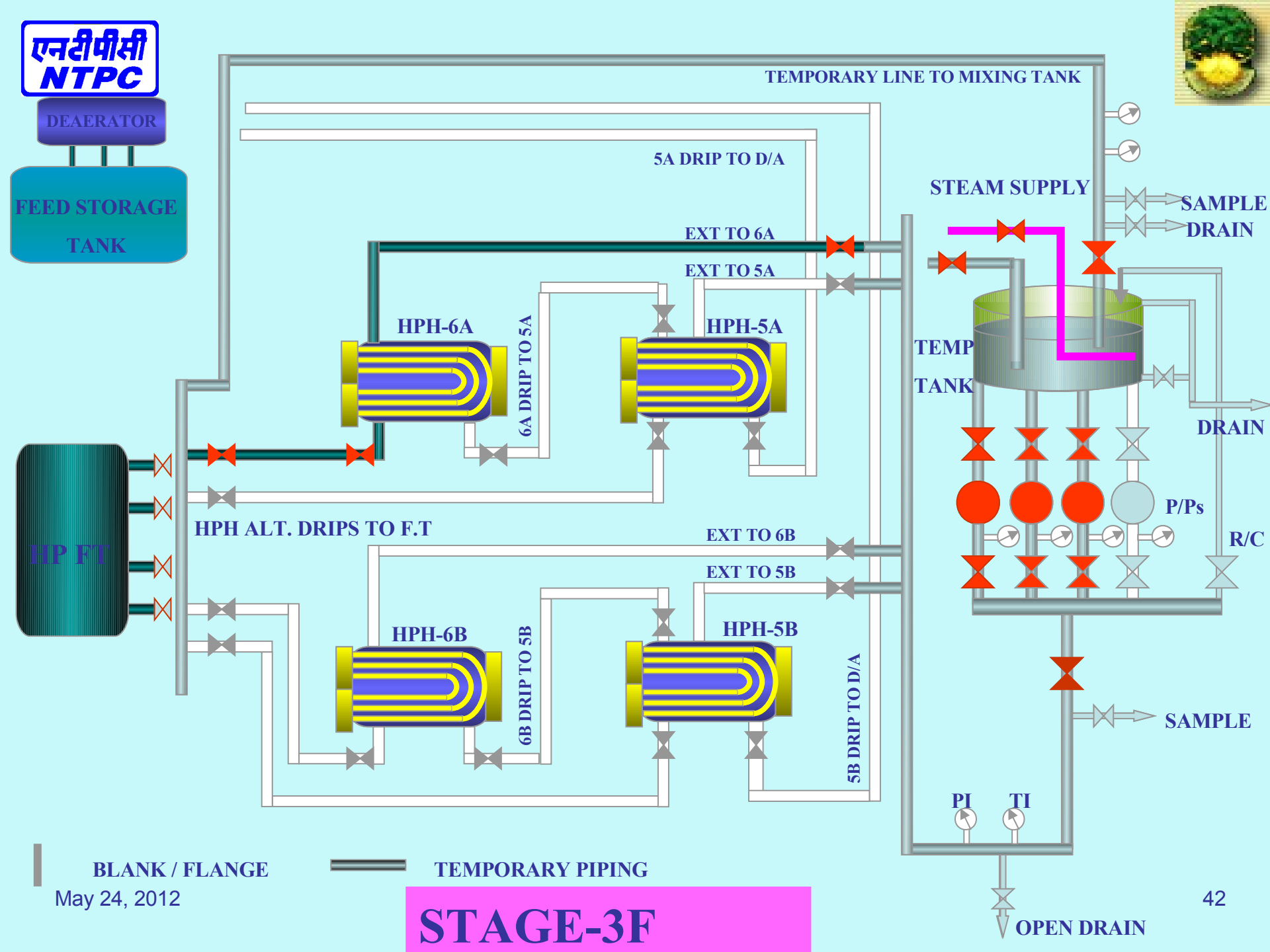
DEAERATOR
FEED STORAGE TANK
5A DRIP TO D/A
STEAM SUPPLY
SAMPLE
DRAIN
EXT TO 6A
EXT TO 5A
HPH-6A
6A DRIP TO 5A
HPH-5A
TEMP TANK
DRAIN
HP FT
HPH ALT. DRIPS TO F.T
P/Ps
R/C
EXT TO 6B
EXT TO 5B
HPH-6B
6B DRIP TO 5B
HPH-5B
5B DRIP TO D/A
SAMPLE
PI
TI
BLANK / FLANGE
TEMPORARY PIPING
OPEN DRAIN



# STAGE-3E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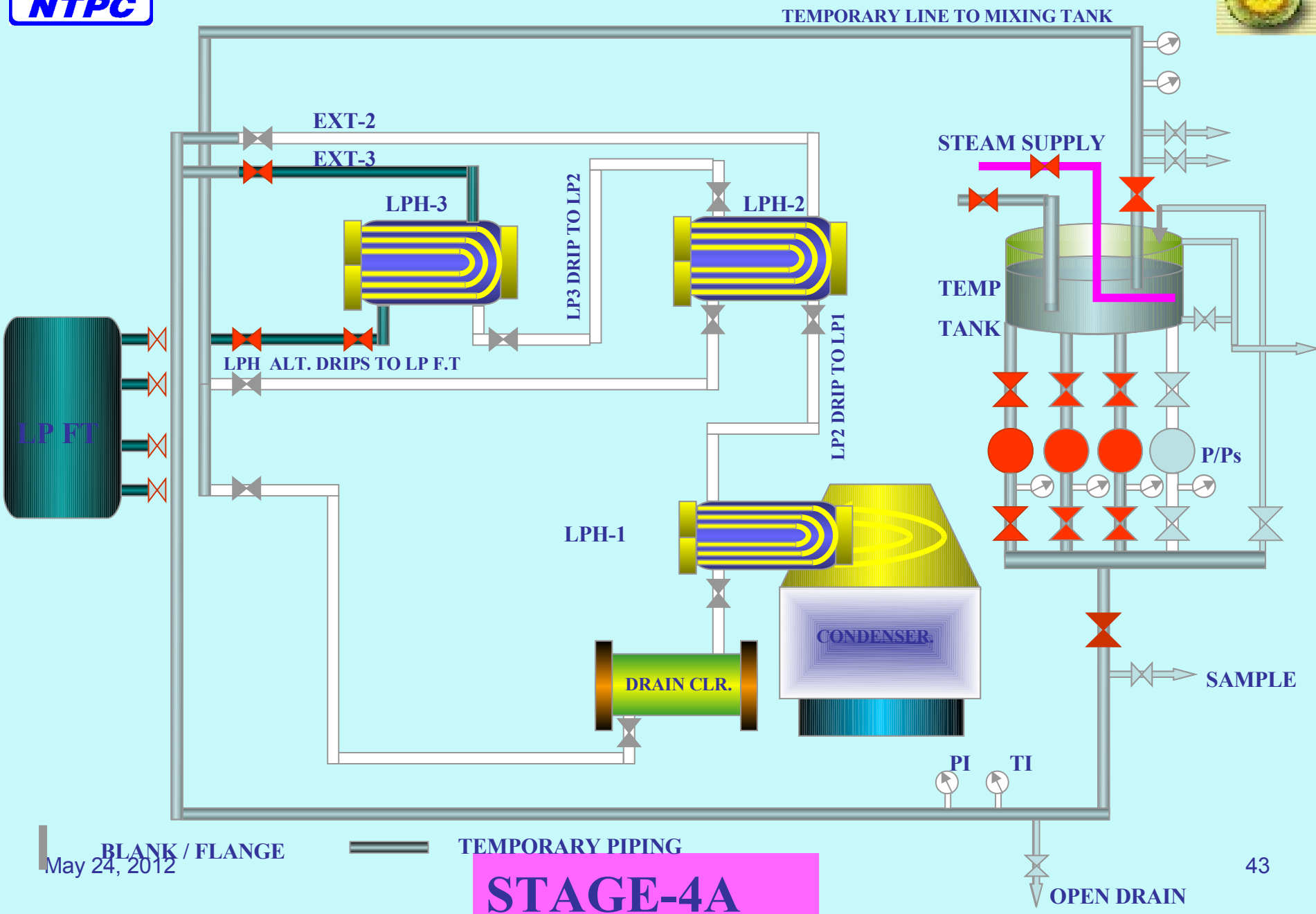
DEAERATOR
FEED STORAGE TANK
5A DRIP TO D/A
STEAM SUPPLY
SAMPLE
DRAIN
EXT TO 6A
EXT TO 5A
HPH-6A
6A DRIP TO 5A
HPH-5A
TEMP
TANK
DRAIN
HP FT
HPH ALT. DRIPS TO F.T
P/Ps
R/C
EXT TO 6B
EXT TO 5B
HPH-6B
6B DRIP TO 5B
HPH-5B
5B DRIP TO D/A
SAMPLE
PI
TI
BLANK / FLANGE
TEMPORARY PIPING
OPEN DRAIN

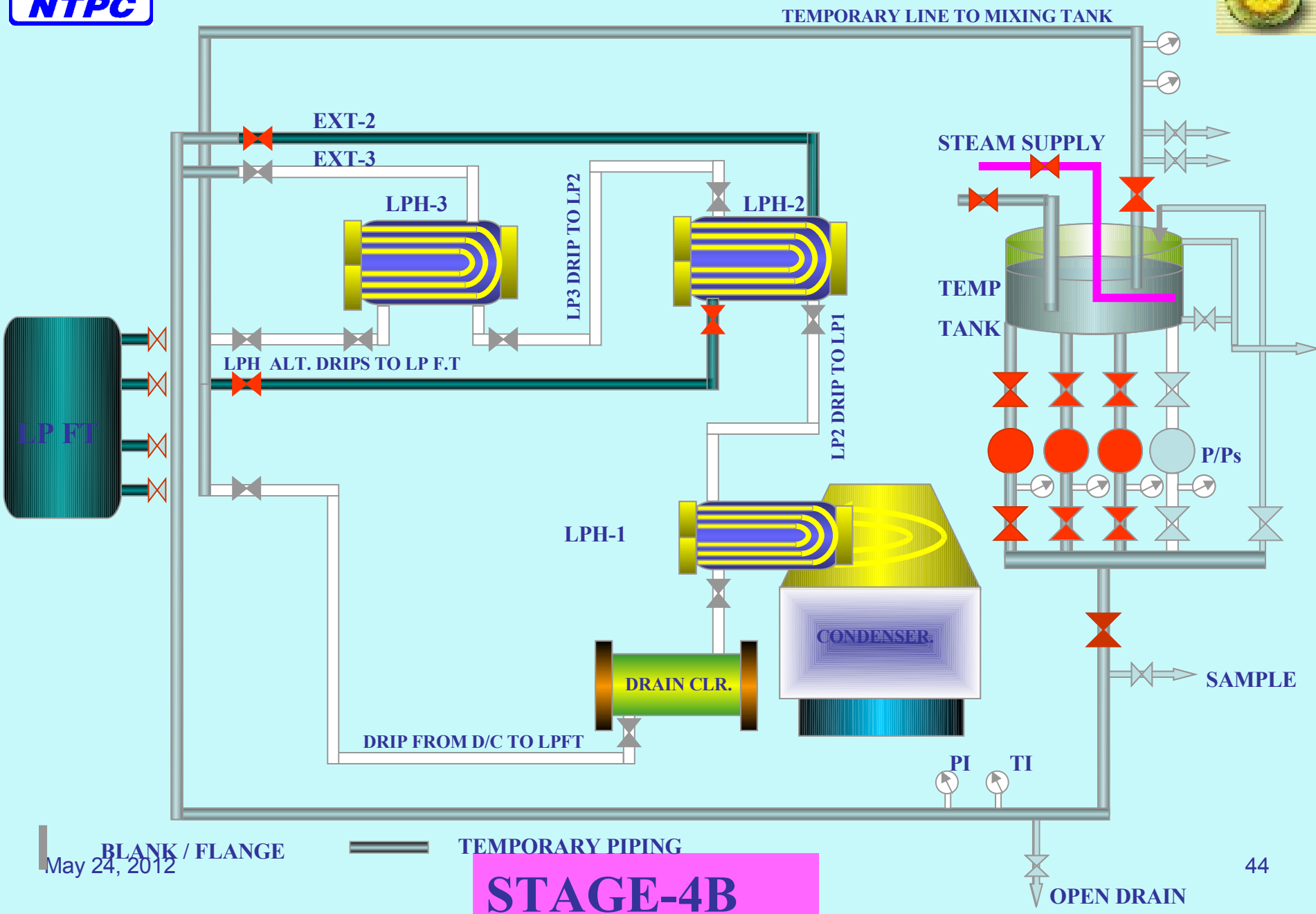


# STAGE-3F


TEMPORARY LINE TO MIXING TANK
EXT-2
EXT-3
LPH-3
LPH-2
LP3 DRIP TO LP2
STEAM SUPPLY
TEMP
TANK
LPH ALT. DRIPS TO LP F.T
LP FT
LP2 DRIP TO LP1
P/Ps
LPH-1
CONDENSER.
DRAIN CLR.
SAMPLE
PI
TI
BLANK / FLANGE
TEMPORARY PIPING
OPEN DRAIN

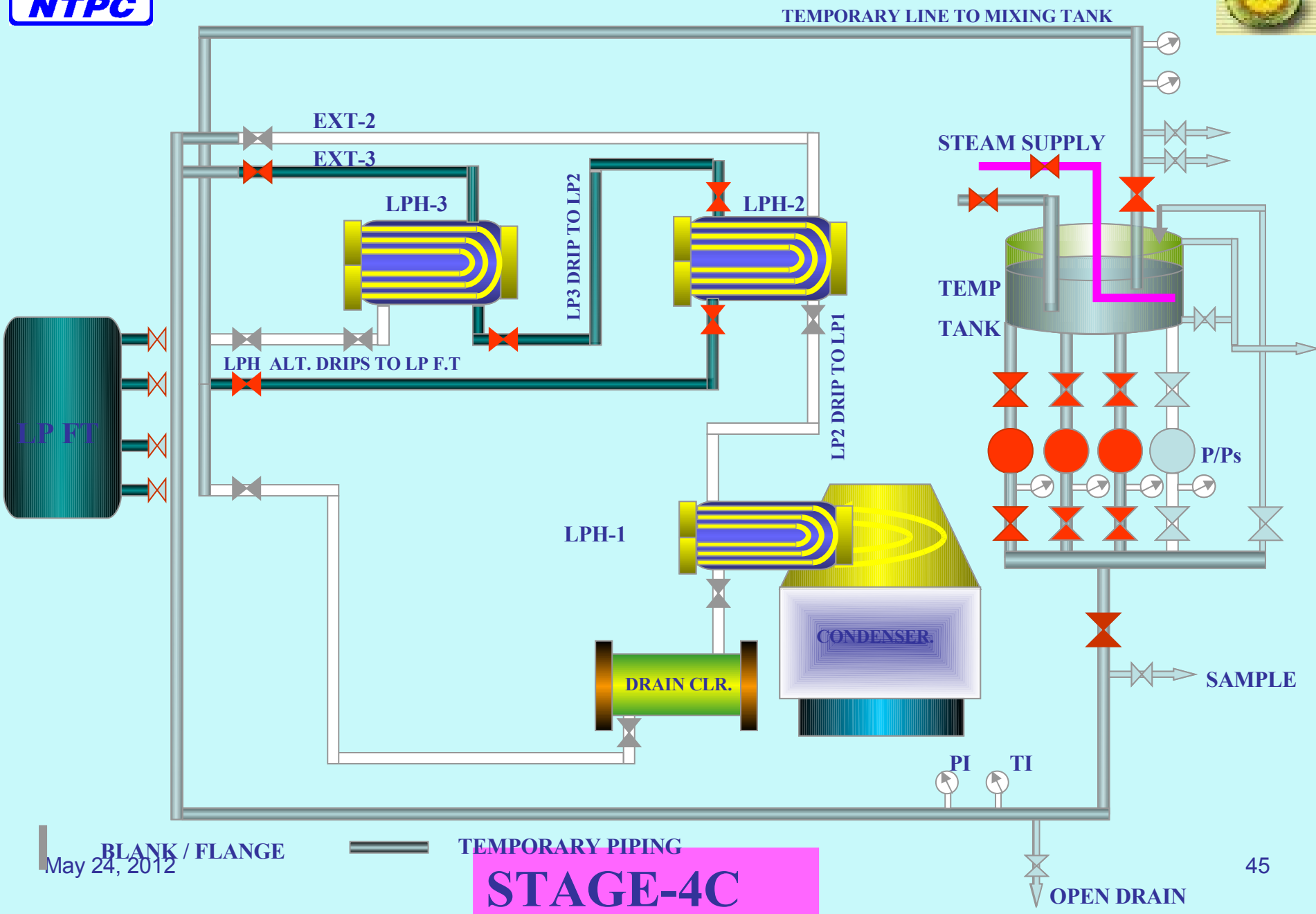


STAGE-4A


TEMPORARY LINE TO MIXING TANK
EXT-2
EXT-3
LPH-3
LPH-2
LP3 DRIP TO LP2
STEAM SUPPLY
TEMP
TANK
LPH ALT. DRIPS TO LP F.T
LP FT
LP2 DRIP TO LP1
P/Ps
LPH-1
CONDENSER
DRAIN CLR.
SAMPLE
DRIP FROM D/C TO LPFT
PI
TI
BLANK / FLANGE
TEMPORARY PIPING
OPEN DRAIN

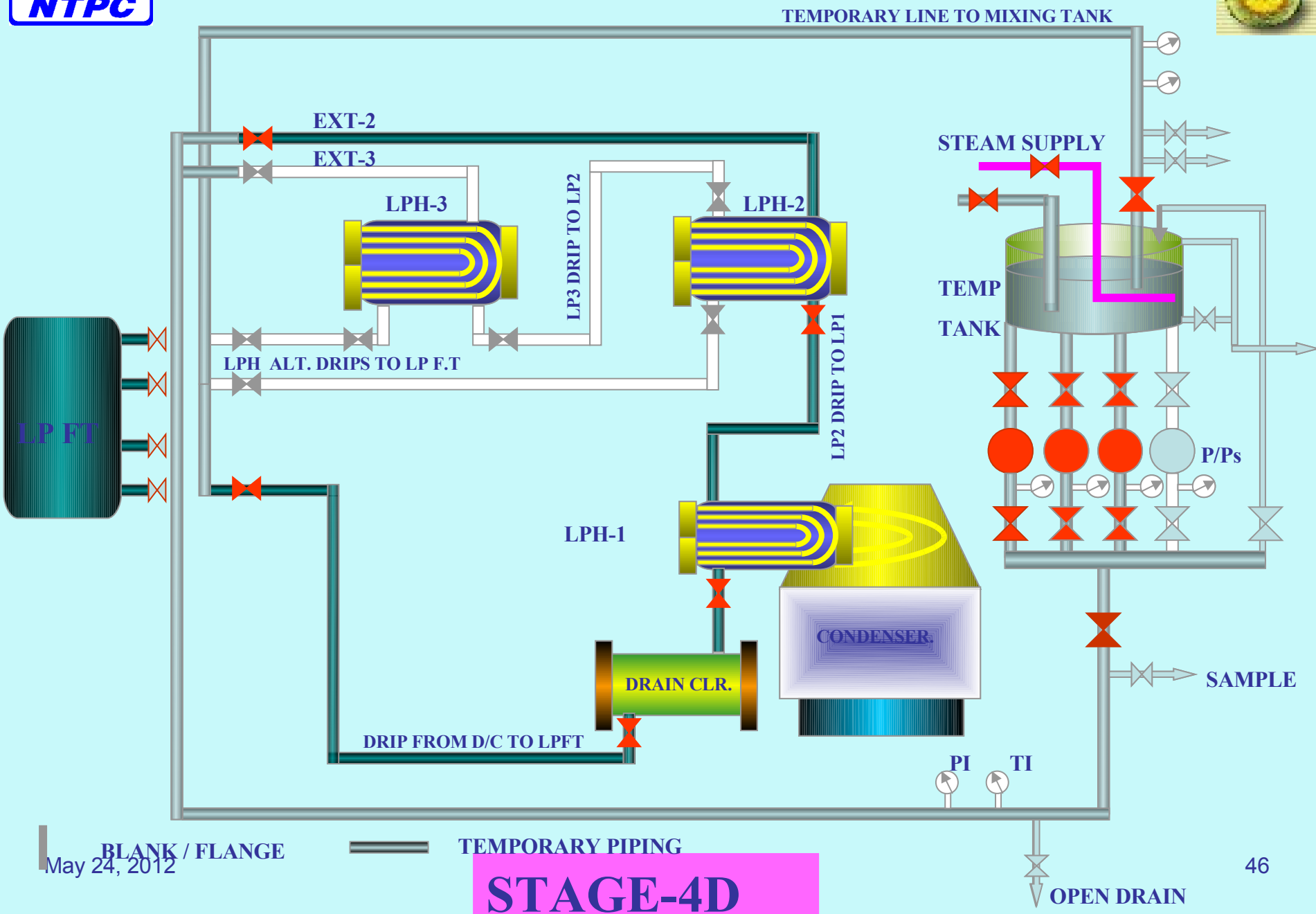


STAGE-4B


TEMPORARY LINE TO MIXING TANK
EXT-2
EXT-3
LPH-3
LPH-2
LP3 DRIP TO LP2
STEAM SUPPLY
TEMP
TANK
LPH ALT. DRIPS TO LP F.T
LP FT
LP2 DRIP TO LP1
P/Ps
LPH-1
CONDENSER.
DRAIN CLR.
SAMPLE
PI
TI
BLANK / FLANGE
TEMPORARY PIPING
OPEN DRAIN



STAGE-4C


TEMPORARY LINE TO MIXING TANK
EXT-2
EXT-3
LPH-3
LPH-2
LP3 DRIP TO LP2
STEAM SUPPLY
TEMP
TANK
LPH ALT. DRIPS TO LP F.T
LP FT
LP2 DRIP TO LP1
P/Ps
LPH-1
CONDENSER.
DRAIN CLR.
SAMPLE
DRIP FROM D/C TO LPFT
PI
TI
BLANK / FLANGE
TEMPORARY PIPING
OPEN DRAIN



STAGE-4D

# COMMISSIONING OF LPH & HPH

# HP / LP Heaters commissioning

- Objective:
  - To commission 2 sets of HP Heaters 5A/6A and 5B/6B
  - Make them available for unit operation.

# HP / LP Heaters commissioning

- State of the plant:
  - HP Heaters 5A, 5B, 6A and 6B are erected as per recommended drawing.
  - Detergent flushing completed
  - Stand Pipe, Level transmitters, Level switches and Level gauge glass are erected.
  - Hangers and supports erected
  - Startup and continuous vent line with orifice are erected.
  - Insulation completed

# HP / LP Heaters commissioning

- State of the plant:
  - Commissioning of all related valve done
  - Simulation checking of all interlocks and protections are complete.
  - Feed water charged to all Heaters and BFP in service
  - All local and remote instrumentation of heaters complete.

# HP / LP Heaters commissioning

- Method:
  - Charge feed water and Bypass closed
  - Charge level switches / transmitters / gauges
  - Open drain line isolating valves
  - Check extraction oil relay operation
  - Open shell side start up vent
  - Ensure interlock in ATRS for solenoid valve A5 are available and checked.

# HP / LP Heaters commissioning

- Method:
  - Ensure the following interlock protection for any one of Heaters 5A, 6A level very high.

    (a) Closure of Extraction steam valves for the HPH 5A and 6A.

    (b) Opening of extraction line drain valves

    (c) Bypassing of HPH on feed water side

    (d) Opening of emergency drain control valve to flash tank

# HP / LP Heaters commissioning

- Method:
  - Ensure turbine load more than 40%
  - Keep feed water valves on auto.
  - Charge extraction steam to HPH 5A gradually with drain control valve to flash tank (emergency drain) in open position.

# HP / LP Heaters commissioning

Method:

- As the heater shell pressure increases more than deaerator pressure, open drain control valve to deaerator (normal drain).
- Build up heater level to normal operating level and ensure control valve operation on auto.
- Observe temperature raise in feed water outlet of heater.
- Close startup vent of HPH5A and keep continuous operating vent in open condition

# HP / LP Heaters commissioning

- Monitor and record the following parameter at various load/full load
  - (a) Extraction pressure
  - (b) Extraction temperature
  - (c) Heater shell pressure
  - (d) Drain temperature
  - (e) Feed water inlet temperature
  - (f) Feed water outlet temperature
  - (g) Heater level
  - (h) Swing check NRV flap positions
  - (i) Heater drip control valves positions.

# HP / LP Heaters commissioning

- Charge HPH 6 A with extraction steam gradually.
- Build up HPH 6A level to normal level with normal level controller. Keep the emergency controller on auto
- Monitor and record all parameters at various load/full load for HPH 6A as done for HPH 5A
- Commissioning of HP Heaters 5B and 6B is carried out in the same way as done for HP Heaters 5A and 6A.

# Turbine and auxiliaries

- Barring gear
  - Preparation
  - Trial run of motor
  - Preparation for putting the barring gear in operation

# TG On barring gear

# TG on barring gear

- Objective:
  - To rotate the turbine rotor system continuously on low speed during start up and shutdown of the machine.
  - This is to over come the break away torque during startup and enable uniform cooling of the rotor system during shutdown to prevent distortion of rotor.

# TG on barring gear

- Services required
  - Auxiliary oil pumps.
  - DC Emergency oil pump.
  - Jack oil pumps AC & DC.
  - Oil Vapour fans
  - Power and control supply for the above.
  - Gate valve gearing with power supply.

# TG on barring gear

- Services required
  - Cooling water to oil coolers.
  - Availability of oil temperature controller.
  - Required operating personnel.
  - Availability of fire fighting system.
  - Proper lighting arrangement in all the floors.
  - All working areas shall be free of debris and no oil accumulation.

# TG on barring gear

- State of the plant:
  - Any one of AOPs is in service and the other is kept on standby.
  - DC emergency oil pump is on auto mode.
  - JOP is in service.
  - DC Jop is kept on auto mode.
  - Oil temperature controller is put on auto.
  - Coolers are charged with cooling water.

# TG on barring gear

- State of the plant:
  - All Turbovisory instrumentations are kept in service.
  - Machine is ready for barring gear operation.
  - Open and close limit switches of gate valve gearing is set and the
  - operation of valve is checked.
  - Throttles in the lube oil line to individual bearing are set for its
  - required flow. Turbovisory instruments are calibrated & ready for
  - barring operation.

# TG on barring gear

- Method:
  - Start AOP and set throttles of header and individual bearings to maintain pressure
  - SLC of oil system checked
  - OTCV commissioned
  - SLC of JOP checked and PRV adjusted
  - Start JOP and check bearing lift(0.02mm-0.1mm)
  - Do hand barring and check freeness

# TG on barring gear

- Method:
  - Do the P&I Checks of barring gear
  - Open barring gear valve and see that specified speed is attained
  - Check for rubbing sound from seals / bearings
  - If ok…run it for 8hours and check performance
  - Close the valve and note coasting down time

# TG on barring gear

Note down the following readings every hour.

1. Lube oil header pressure after filter
2. Lube oil temperature after cooler
3. Thrust bearing position.
4. Bearing and shaft vibration
5. Speed
6. Bearing Babbitt temperature.
7. JOP header pressure and the same at individual bearing.
8. Return oil temperature at all bearings.
9. Return oil flow levels.

# TG on barring gear

- COMPLETION CRITERIA:
  - If the above parameters for 8 hrs. Barring is found normal, the trial run of barring gear operation is successful.

# Condenser flood test and Vacuum tightness test

# Flood test

- Services required
  - D.M water
  - Flexible hose pipe
  - Lighting
  - Dewatering pump
  - Wooden slippers for temporary support

# Flood test

- State of the plant
  - Condenser erection completed
  - Flexible polythene hose fitted for level monitoring
  - Jack bolts beneath condenser locked
  - Wooden planks kept
  - D.M Water line charged

# Flood test

- Method
  - All heater vents opened to vent out the air
  - Start DM Water filling
  - Check leakages for every one meter raise in level (in level indicator)
  - Fill water up to the tip of LP Turbine blades
  - Attend leakages
  - Drain condenser, clean Hotwell and remove wooden slippers and release jack bolts

# Flood test

- Completion criteria
  - Declared completed when all the identified leakages attended satisfactorily

# Vacuum tightness test

- Services required
  - Cooling water available
  - Power supply to CEP, Vacuum pumps and CW Pumps available
  - Auxiliary steam available

# Vacuum tightness test

- State of the plant
  - Vacuum pumps ready for operation
  - GSB trial completed
  - CEP commissioned, P&I checks done
  - Condenser CW water charged
  - Vacuum breaker commissioned
  - TG is on barring gear

# Vacuum tightness test

- Method
  - Put turbine on barring gear
  - CEP is on recirculation
  - Seal steam and GSC lined up
  - GSB and Both vacuum pumps started
  - Charge seal steam after achieving 0.2Ksc vacuum (Seal steam 0.01Ksc and >160$^{0}$c temp)

# Vacuum tightness test

- Check for air ingress and attend leakages
- Stop one vacuum pump at desired vacuum
- Check for holding with one pump
- If air ingress points are not detected then use helium leak detection or steam pressurization method (Raise steam space pressure up to 0.1Ksc.)

# Vacuum tightness test

- Completion criteria
  - Stop both vacuum pumps at desired pressure and observe rate of fall of vacuum. (Should not be >2to3 mmwcl per minute)
  - Total hogging time for achieving desired vacuum with both pumps and with individual pumps to be noted

# Checklist for rolling

- Electrical supply HT&LT charged
- DM Water available in FST and Hotwell
- Turbovisory parameters are working
- Mot instruments working
- Regenerative system controls checked
- Start CW and charge passes
- Start ACW and charge lines
- Start ECW and charge equipment

# Checklist for rolling

- Start mot VEF
- Start AOP &JOP and note pressures
- Ensure return oil flow from bearings
- Ensure all DC pumps are available
- Start control fluid pump and charge lines
- Check bearing temperatures
- Maintain lube oil temperature
- Check barring gear interlocks

# Checklist for rolling

- Put seal oil system in service and do P&I checks
- Put turbine on barring and note readings
- Ensure all mal drains are open
- Check governing characteristics of valves
- Ensure MS, CRH, HRH drains in open
- Ensure extrn valves are closed

# Checklist for rolling

- Start CEP and open GSC min recirculation
- Charge gland sealing
- Open heaters shell vents to condenser
- Close vacuum breaker
- Start vacuum pulling
- Charge seal steam
- Ensure MS/ CRH /HRH line warming

# Checklist for rolling

- Check turbine and generator protections
- Check heaters protections and interlocks
- Ensure HP&LP bypass available
- Start MDBFP and charge feed water system
- Put HP-LP bypass in operation
- Ensure rolling parameters

# Checklist for rolling

- Start rolling in SGC or raise starting device position to open stop valves
- Check that all steps are satisfied
- Soak the turbine at 360rpm
- Cross critical speed at set acceleration
- Be ready for synchronization after achieving 3000rpm

# THANK YOU