12. VENTILATION OF THE PUMPING STATION (DVP)

12.1. SYSTEM ROLE

The role of the DVP system is to recycle the air and maintain ambient conditions compatible with the correct operation of equipment within the pumping station, the SEC [ESWS] tunnels and the fire pump room (beneath the pre-discharge structure).

It also contributes to the containment of fires and ensures that smoke is extracted from the rooms after a fire.

12.2. DESIGN BASES

The safety requirements are given in Chapter I.4.0.

The safety role of the DVP system is to maintain the ambient conditions compatible with the correct operation of the safety classified SEC [ESWS] pumps and CFI [CWFS] equipment.

It has two main functions:

- Cooling of the CFI [CWFS] filtering system, the SEC [ESWS] pumps, "low speed" motors and "low pressure" washing pumps.

- Heating the rooms housing classified equipment.

The safety classification, is given in Chapter C.2.2.

Design assumptions:

- The air recycling rate for rooms subject to non-specific pollution is 0.5 vol/hr.

- The external temperatures and humidity conditions and the ambient conditions to be maintained in the rooms are given in Chapter I.4.1. The rooms housing classified SEC [ESWS] and CFI [CWFS] equipment are maintained at a temperature of between 5°C and 40°C to ensure the availability of these systems.

Air recycling:

- The air in the pumping station rooms, the SEC [ESWS] tunnels and the fire pump room is constantly recycled.

- Outside air is let in through transfers between the rooms, except in the electrical rooms for which the air is filtered (to remove salt) and blown (maintaining an overpressure) to protect the equipment.

- The "polluted" air is removed through extraction.
Heating:
- Heating is provided by unit heaters and heating elements.
- The heat released by the motors of the main pumps, when in operation, help to heat the halls and the rooms during winter.
- During periods of extreme cold, the minimum temperatures in the pumping station rooms and the SEC [ESWS] tunnels are maintained so that no classified equipment fails to operate or is damaged.

Cooling:
- The rooms are cooled using ventilation and air treatment units.
- In order to limit the increase in temperature of the SEC [ESWS] wells, the heat dissipated by the SEC [ESWS] motors during the summer is released externally through a specific recycling device.

Fire protection and smoke extraction:
- In a fire, the stairwells providing access to the SEC [ESWS] wells are kept in a state of overpressure by a ventilation system open to the outside.
- Data regarding smoke extraction will be provided in later documents.

12.3. DESCRIPTION OF THE INSTALLATION

The ventilation systems of each module of the pumping station and the associated SEC [ESWS] tunnel are separate. Each module consists of an open system with partial recycling in winter.

Each pumping station module includes:

for air recycling:
- An air intake,
- Air transfer grids to let fresh air into the rooms (except for the electrical rooms),
- A blower and a filter to let fresh air into and overpressurise the electrical rooms,
- A network of extraction ducts leading from each ventilated room that converge towards an extraction fan in the ventilation room (the air is then discharged from the roof through a duct),
- Two extractor fans at either end of the SEC [ESWS] tunnel (BAS [safeguard building], diesel generator room side))

for the heating of rooms housing classified equipment:
- Unit heaters controlled by thermostats distributed in the rooms,
- A CFI [CWFS] filter heating device: heating elements for chain filters and blowing of hot air for the drum screen compartment,
Low temperature monitoring thermostats in the SEC [ESWS] well and around the CFI [CWFS] filtering system "low speed" motor,
for the heating of the various rooms:
- Unit heaters controlled by thermostats distributed in the rooms,
- Devices for recycling the heat dissipated by the main motors,

for the cooling of the CFI [CWFS] filtering system, the SEC [ESWS] pump, the "low speed" motor and the "low pressure" washing pump:
- A two position (winter/summer) air recycling device between the SEC [ESWS] well, the hall and the outside. The circulation of air is ensured by a fan built into the SEC [ESWS] motor,
- A high temperature monitoring thermostat in the SEC [ESWS] well,
- An air treatment unit in the CRF (water circulation) motor room (Divisions 2 and 3 only),
- A high temperature monitoring thermostat on the CFI [CWFS] filtering system "low speed" motor,

for the cooling of the various rooms:
- Air treatment units in the electrical rooms and the electrochlorination rooms,

for the extracting of smoke from the rooms:
- A stairway overpressure system (external air intake duct, blower and discharge duct).

The fire pump room ventilation system is separate. It operates as an open system.
The fire pump room includes:
- An air intake,
- An extractor fan (designed to recycle air and cool the pump motors),
- A heating device.

12.4. OPERATING PRINCIPLE

12.4.1. Normal permanent loads:
The ventilation system is always in operation:
There are two normal permanent load scenarios during which the ventilation system automatically operates in each module:
- Winter:
Air recycling is provided.

- The heating equipment is in operation and controlled by temperature sensors.
- The heat recycling devices join in the hall; their operation is effected by operation of the pump motors.
- The system for recycling the air in the CRF motor room, the hall and the CRF pump room is in operation (fan running).
- The air treatment units remain in operation.

- **Summer:**
  - Air recycling is provided.
  - The heating equipment is shut down.
  - The recycling devices join outside.
  - The air treatment units remain in operation and operate independently.

**12.4.2. Special permanent loads:**

- **Extreme cold:**
  - The heating equipment in operation during "winter" load conditions is designed for extreme cold.

- **External undervoltage (MDTE [LOOP]):**
  - The heating equipment or the air treatment units required to maintain temperatures so that classified equipment does not fail or become damaged is backed up by the main diesel generators.

**12.5. PRELIMINARY SAFETY ANALYSIS**

**12.5.1. Compliance with regulations**

To follow.

**12.5.2. Conformance with functional criteria**

The system design enables it to maintain ambient conditions compatible with the correct operation of the safety classified equipment installed in the pumping station. It has been verified that, using the assumptions defined in Chapter C.3, these ambient conditions are met for extreme climatic conditions for the pumping station rooms containing classified equipment belonging to the SEC [ESWS] and CFI [CWFS] systems.
12.5.3. Compliance with design requirements

12.5.3.1. Safety classification

The compliance of the design and construction of equipment with requirements derived from classification rules is detailed in Chapter C.2.2.

12.5.3.2. Single failure criterion

The physical separation of the ventilation system for the four pumping station divisions allows the single failure criterion to be met.

12.5.3.3. Qualification

The system components are qualified to perform their safety function and to adapt to the safety conditions to which they are subjected during the performance of their role.

12.5.3.4. Instrumentation and control

The compliance of the design and construction of equipment with requirements derived from instrumentation and control classification rules is detailed in Chapter C.2.

12.5.3.5. Uninterruptible power supplies

The heating or cooling equipment required to maintain ambient conditions in the event of an MDTE [LOOP] are backed up by the main diesel generators.

12.5.3.6. Hazards

External hazards

The classified equipment is protected against the external hazards presented in Chapter C.3 by the general or specific measures described in the table below:

<table>
<thead>
<tr>
<th>External hazards</th>
<th>Protection required in principle</th>
<th>General protection</th>
<th>Specific protection introduced in the design of the system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthquake</td>
<td>Yes for F1B parts</td>
<td>Installed in SC1 SDP [pump house]</td>
<td>SC1 design for F1B equipment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SC2 design for F2 or non-classified equipment (on a case-by-case basis)</td>
</tr>
<tr>
<td>Aircraft crash</td>
<td>Yes for F1B parts</td>
<td>SDP [pump house]: geographic separation and in bunker</td>
<td></td>
</tr>
<tr>
<td>External explosion</td>
<td>Yes for F1B parts</td>
<td>Installed in protected SDP [pump house]</td>
<td>Dampers on the air inlets and discharge</td>
</tr>
<tr>
<td>External flooding</td>
<td>Yes for F1B parts</td>
<td>SDP [pump house] design</td>
<td>Equipment setting</td>
</tr>
</tbody>
</table>
Snow and wind | Yes | Installed in protected SDP [pump house] | - \\
Extreme cold | Yes | Design input data \\
Electromagnetic interferences | Yes for F1B parts | Installed in protected SDP [pump house] | - \\

**Internal hazards**

The physical and electrical separation of the ventilation system of each of the pumping station divisions meets the need for protection against internal hazards as described in Chapter C.4.

<table>
<thead>
<tr>
<th>Internal hazards</th>
<th>Protection required in principle</th>
<th>General protection</th>
<th>Specific protection introduced in the design of the system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakages of piping</td>
<td></td>
<td>Not applicable</td>
<td>-</td>
</tr>
<tr>
<td>Ruptures of tanks, pumps and valves</td>
<td></td>
<td>installation in the 4 separate SDP [pump house] divisions</td>
<td>-</td>
</tr>
<tr>
<td>Internal missiles</td>
<td>No loss of more than one train for F1B parts</td>
<td>installation in the 4 separate SDP [pump house] divisions</td>
<td>-</td>
</tr>
<tr>
<td>Dropped loads</td>
<td></td>
<td>installation in the 4 separate SDP [pump house] divisions</td>
<td>-</td>
</tr>
<tr>
<td>Internal explosion</td>
<td></td>
<td>installation in the 4 separate SDP [pump house] divisions</td>
<td>-</td>
</tr>
<tr>
<td>Fire</td>
<td></td>
<td>installation in the 4 separate SDP [pump house] divisions</td>
<td>-</td>
</tr>
<tr>
<td>Internal flooding</td>
<td></td>
<td>installation in the 4 separate SDP [pump house] divisions</td>
<td>-</td>
</tr>
</tbody>
</table>

**12.6. TESTS AND MAINTENANCE**

All the classified electrical equipment within the DVP system is subject to periodic tests.

The tests are carried out during plant operation. They are conducted on each train successively, rather than simultaneously.

Clogging of the filters is regularly checked.

The preventive maintenance of the heating equipment and air treatment units is performed during "summer" load conditions and "winter" load conditions respectively. That of a module's other ventilation equipment is carried out at the same time as the maintenance of the associated SEC [ESWS] train.

The air treatment units are serviced in accordance with the manufacturer's guidelines.

**12.7. FUNCTIONAL FLOW DIAGRAM**

To be given during the detailed design phase.