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OSIRIS REACTOR DESCRIPTIVE REPORT

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Translated from the French by P.E. Moles

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Translation of Chapter VI of

OSIRIS REACTOR DESCRIPTIVE REPORT

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VI - VENTILATION

(Pages 71 to 78)

VI.1 PURPOSE OF THE SYSTEM

The system has both a safety role and an air conditioning one.

VI.1.1 THE SAFETY ROLE

The confinement of radioactive gases and particles:
The confining is not achieved by the integrity of the containment structure. Certainly the structure is "airtight" (In terms of the building boundaries, access doors with sealing airlocks, pipe penetrations and electric cable penetrations etc.). But an inwards leakage rate of 2000m^3/h must be accepted (trials gave a figure of 650m^3/h) at the nominal negative pressure of 5 mm of water. In fact therefore it is this negative pressure, which is permanently maintained, which ensures against radioactive release by other than properly designed (and protected) systems.

The capture of radioactive gases from the pool surface:

A "sweeping" airflow over the pool surface prevents the escape of these gases into the reactor hall.

Fixed filtration system: (Active Exhaust System) For each system and sub system, groups of filters treat the air before it is discharged to atmosphere. This is done in normal operation as well as under "accident" conditions. These radioactive byproducts are filtered in this way without it being necessary to start up a special safety system.

In the safety role this function must be permanently achievable. This is why in both the supply and exhaust system there are three fans, of which only two are operating, the third one starting automatically should either of the others fail. To this end the fans are electrically fed from the guaranteed supply circuit.

VI.1.2 THE AIR CONDITIONING ROLE

The object of the air conditioned supply is to provide normal working conditions for the personnel, and high reliability of equipment by keeping adequate temperature (and humidity) control.

The conditioned space is kept at:-

	Temperature	Humidity
Winter	20°C ± 2°C	50% ± 10%
Summer (max.)	20°C	55%

VI.2 THE SYSTEM AND AREAS VENTILATED

VI.2.1 GENERAL LAYOUT

The OSIRIS-ISIS complex is ventilated and conditioned by a single system, divided into several branches so that the conditions required in the various zones can themselves be different. The branching takes place after the supply fans, and rejoins again after the filters into the same extraction circuit for discharge to atmosphere.

VI.2.2 AREAS VENTILATED

The areas ventilated are situated in three zones.

- The OSIRIS containment
- The active workshop hall
- The ISIS containment.

VI.2.2.1 The OSIRIS Containment

The air supply rates have been calculated to ensure good conditioning, to cope with the sources and levels of heat release, and depletions to the exterior.

- Level - 11m
  - No heat source
  - Air changes per hour 1.2.
- Level - 8m
  - 20 KW max. (from experiments if operating).
  - Air changes per hour 5.3.
- Level - 4m
  - 30 Kw max. (from experiments if operating).
  - Air changes per hour 5.7.
- Level 0m and + 4m
  - 30 Kw if experiments operating at level 0m.
  - 20 KW if experiments operating at level + 4m.
  - Release of water vapour from pools and canals whose temperatures are normally 35°C with a 40°C maximum for the pool.

. Total air changes per hour 1.4.

Pool Surface

..e surface of the OSIRIS pool is swept permanently (all year round) by a current of hot air, discharged by louvres disposed along the west side of the pool, and extracted by louvres disposed along the east side. The discharge and exhaust velocities are of the order of 7 m/s.

- Other Areas

Air is also extracted from other isolated localities in the complex, such as

. The "Salle des mécanismes" - 15m (Control Rod Drive Room)
. The "Salle de DRG" and transfer (Cladding Failure Detection Room).
. The pool drainage tank.
. The pump room.
. The core and pool heat exchanger pits.

VI.2.2.2 The Active Workshop Hall

The arrangement of the airflows in the active workshop hall was dictated by the hot cells, but they are compatible with good air conditioning in the hall.

(a) The Exhaust Flow from the Cells

The air sweeping the cells is taken from the hall itself, and is filtered before entry into each cell. The flow rate depends on circumstances.

- The norm. case; hot cell doors closed, the air change rate is 20 per hour.
- The "on. door open" case; the air flow from the outside to the inside must have a velocity of about 0.5 m/s.

Only one door may be open at a time.

(b) Flow in the Hall

An ai low corresponding to the "1 cell door open, one closed" case is sufficient for the conditioning of the hall. The total flow sweeping the hall is therefore limited to this value, the points of extraction obviously dep. .d on the mode of op. tion.

VI.3 CHARACTERISTICS AND DESCRIPTION OF THE SYSTEM

VI.3.1 EQUIPMENT LOCATION

All the hardware necessary for conditioning the air, and the supply fans are grouped in an area in the North East part of the circular gallery at the -4m level. The filters and exhaust fans occupy the Northern part of the basement of the active workshops. These areas are adjacent to each other but not joined.

VI.3.2 SUPPLY CIRCUIT (Blower Circuit)

The air discharged is conditioned air.

The total flow is 59300 m^3/hr.

VI.3.2.1 Fresh Air Inlet

The fresh air inlet is drawn in from outside the building via an inlet in the North side of the circular gallery at level 0.0m. The intake has a battery of industrial filters which are not inflammable.

VI.3.2.2 Supply Fans (Blowers)

The three fans are in parallel.

Two are used in normal operation with the third as standby.

VI.3.2.3 Freeze Protection

In order to avoid conditioning coil freeze up in certain circumstances, a heating coil preheats the air when the outside temperature falls below 5^{o}C.

VI.3.2.4 Air Conditioning Unit Enclosures

These are split into 5 separate units corresponding to the zones they serve.

- The Pool Surface Sweep System

  This system contains only a heating coil.

- The OSIRIS Reactor Hall System

  The conditioner unit for this system contains

  . A primary coil
  . A dehumidifyer
  . A cooling coil
  . A secondary heating coil.

- The OSIRIS Basement, Active Workshop Hall and ISIS Reactor System.

  These three systems are each provided with a unit wholly analogous to the previously described one, but of smaller capacity.

VI.3.2.5 Standby Heating System

In case of a failure of the pressurised hot water system, a hot air generator operating on domestic fuel can maintain internal temperatures at a reasonable level, should it be necessary.

To assist the standby heating system the air changing flow of the complex can be reduced by stopping the (supply) fans.

VI.3.3 EXHAUST (OR EXTRACTION) CIRCUITS

The principle of horizontal sweeping flow has been adopted. For each supply circuit therefore there is a corresponding extraction circuit situated at the same level.

For safety reasons, the extraction circuits for each building do not rejoin again until after the filters.

VI.3.3.1 The (Extraction) Systems

One must distinguish between the following systems:

(a) The OSIRIS Containment System

Exhaust air is taken from the following localities

- From the upper part of the reactor hall (at the level of the walkway)
- From the +4m level
- From the 0m level
- From the pool sweeping flow
- From the basement

This comes from several levels.

The system also serves the primary circuit pump motors, where there is a heat release of about 500 Kw.

(b) The Active Workshops Hall System

(c) The Hot Cells System

(d) The ISIS System.

For each of the four extraction systems there is a corresponding bank of filters.

After filtration, the air is ducted to the exhaust fans and discharged to atmosphere via the stack.

VI.3.3.2 The Exhaust Fans

There are three exhaust fans in parallel. Two are normally running with the third on standby. All three fans discharge into the same plenum connected to the stack.

VI.3.3.3 The Discharge Stack

The stack is located 10 metres north of the buildings. It is 45m high.

VI.3.3.4 The Exhaust System Filters

Before discharge to atmosphere, the air undergoes a double filtration process,

- once through High Efficiency (HEPA) filters, which are non-inflammable, and capable of arresting particles, and solid fission products,
- once through activated charcoal filters, capable of absorbing gaseous fission products, notably the Iodines.

(a) Placement of Filters

The exhaust system filters are set in concrete casemates, located the northern area of the active workshops at level -4m.

(b) Absolute Filters

The filter element is chevron shaped and of asbestos paper. The filter efficiency is 99.95% for particles down to 0.3 microns in size.

(c) Iodine Filters

With each absolute filter there is an associated iodine filter (except for the extraction circuit in the zone behind the active workshops).

The filter element is a cartridge of activated charcoal, (NC 8.16 ref. C.E.C.A.) with a minimum efficiency of 10^2. (Translators note: This is as written - it probably represents a decontamination factor, i.e. 99% efficiency).

(d) Handling of Filters

The removal of filters is achieved through the trap doors above the casemates in the zone behind the hot cells.

No special precautions are taken for a routine removal for end of useful life (i.e. clogging up). In the case of an accident, or if the filters are highly active, they can be removed after wrapping in vinyl, in a special "flask" suspended from the crane.

VI.4 REGULATION (OF THE SYSTEM)

The method is the same for both OSIRIS and ISIS. The coars adjustment of negative pressure is manual, by control registers, upstream of the exhaust fans. Fine control is achieved automatically by the adjustment of the air flow which is taken from downstream of the supply fans and by-passed to the upstream (suction) side of the supply fans, which has the effect of lowering the air flow into the containment structure. Other arrangements are made to avoid the negative pressure reading levels which endanger the integrity of the containment (see para 5.4 below).

The reference pressure sensing point is in the "vide sanitaire" (possibly cloak room or clean room) of the OSIRIS containment structure.

The pressure sensing point for the OSIRIS hall, is at level +4m in the hall center.

The pressure sensing point for the ISIS hall is at level +10m in the middle of the east wall of the hall.

The servomoters operating the pressure regulating equipment are supplied by the electrical guaranteed supply circuit.

VI.4.2 REGULATION OF THE PRESSURE IN THE HOT CELLS

The pressure is adjusted in each cell by the manual operation of a register placed in the air entry orifice.

VI.5 SURVEILLANCE AND SAFETY OF THE SYSTEM

VI.5.1 CONTROL OF ZONE PRESSURES

The pressure in the OSIRIS building is indicated on a panel in the control room.

In addition there are three channels connected to manometers (operating on a two out of three system) which initiate a control rod drop if the pressure levels exceed the set limits. The rod drop is delayed (the time is adjustable from 2 to 30 mm). (Translator's note: mm probably a misprint for ms).

The pressure in the hot cells is read locally at each cell.

VI.5.2 OPERATION OF FANS

A flow controller is mounted on the discharge of each fan.

In the control room, the fans which are running are indicated by an illuminated fan running light.

VI.5.3 NON RETURN VALVES

The supply ducts serving both the OSIRIS and ISIS halls are fitted with non return valves (flaps) in order to avoid an accidental overpressure ducting radioactive gases to other areas. These valves are situated within the ducts immediately inside the penetrations into the halls which they serve, and before the first discharge lou..re.

VI.5.4 PRESSJRE LIMITING VALUES

The OSIRIS hall is fitted with two valves. These valves which are airtight at 5 mm of water negative pressure, open when the pressure differential reaches -10 mm of water. The containment building itself is capable of withstanding more than -40mm water gauge.

VI.5.5 SURVEILLANCE OF FILTER PRESSURE DROP

A direct reading differential manometer (one per system) allows, at the outlet from the filter banks, observation of the high efficiency filter pressure drops.

For th odine filters a test filter (witness), for each system allows the condition of the main filters to be assessed. (Translators note: The Ventilation Chapter above makes no special mention of the gaseous effluent circuits as such. The following extract from Chapter III page 34 is therefore annexed to this chapter as it helps in the understanding of the total system). (See also fig. VI-2).

III.1.2.4 EFFLUENTS

- Active water
- Chemical effluent

- Gaesous Effluent

The gaseous effluents are discharged into ducts of P.V.C. and are thus piped to the -4m level of the circular gallery. From there, there are two possibilities:

- 1st possibility: Direct connection into the main exhaust system ductwork before the filter banks of OSIRIS. The Δp available is of the order of 30 mm water gauge. These connections can used if the gaseous effluents do not present significant risks of contamination, nor of chemical activity which would be harmful to the PVC ductwork or activated charcoal filters.

- 2nd possibility: (The more frequent) connection by means of a fan to a system of eight separate tubes of P.V.C. whose discharges are accomplished at various levels in the main discharge stack of OSIRIS.

It is therefore necessary to provide a filtration, and pressure control system upstream of the junction with the experimental position. The type of filter selected depends upon an analysis of the actual experiment being undertaken. The fans however are permanently sited, and have the following characteristics.

Fans:	type PB 150
Air Flow:	$160 m^3/h$
Discharge Pressure:	140 mm water gauge
Motor HP:	1.5 CV (1.5 HP nominal)
R.P.M.	2850

The pressure drop through the pipes is about 60 mm water gauge, the Δp available at the joining point, is of the order of 80 mm W.G.