MATERIALS MANAGEMENT PROCESS DURING THE DISMANTLING OF VANDELLOS I NPP

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1. INTRODUCTION TO THE DISMANTLING PROJECT

The Vandellós I Nuclear Power Plant was a 500-Mwe gas-graphite reactor of the same type as the French ST-Laurent-des-Eaux plants. The nuclear steam supply system was integrated, with the core and the steam generators located inside a prestressed concrete pressure vessel. The reactor vessel is housed in the reactor along with the blowers and auxiliary equipment. The site also includes other buildings such as the irradiated fuel building, fuel pool building, auxiliary electrical and power plant buildings, etc.

The plant was built between 1967 and 1972 and was operated, without significant problems, until 1989, when it was shutdown due to a fire in the turbines. The incident, caused by a mechanical failure, did not produce any radioactive emissions. Nevertheless, the recovery cost of the plant, including new requirements established by the Spanish Nuclear Safety Council, led to the decision to definitely shut the plant down.

Three decommissioning alternatives were studied:

- Indefinite maintenance in shutdown state.
- Stage 2 for the defuelled reactor vessel and contents, with decontamination of most of the rest of the site.
- Immediate dismantling to Stage 3

The alternative chosen was to go to stage 2: Release of 80% of the site, keeping 20% of the site as a regulated area, housing the reactor vessel in a new structure and removing the radioactive waste.

The key reasons for this alternative being selected are the availability of technology, the lower volumes of waste, the lower radiological impact and the lower cost.

Stage 2 will be followed by a 30-year period of dormancy, following which there would be no significant decrease in activity or dose rates.

The process of achieving the dormancy status is being carried out in three phases:

- Preliminary activities, needed to prepare or adapt the auxiliary systems of the plant to the future decommissioning activities (electrical distribution and supply, ventilation systems, alarm control system, etc.). These activities were completed during 1998.

- Dismantling activities, that will take about three years, and will consist of the decontamination and dismantling of the systems and the demolishing of the structures.

- During this phase the materials arising from the decommissioning are being accurately controlled, with different streams being established for conventional materials, declassified materials (with or without restrictions) and radioactive waste, that will be conditioned, temporarily stored and ultimately transported to “El Cabril” (Spanish storage facility for low and intermediate level radioactive wastes).

- Final activities, consisting of rehabilitation and preparation for the tasks to be performed during the period of latency.

The total amount of materials to removed during this phase will amount to approximately 300,000 tons, distributed as follows:

- 2000 t of low and intermediate level radioactive waste, which will be sent to El Cabril.
- 277.000 t of conventional concrete scrap, which will be used to fill the holes left by the dismantled buildings.
- 16.500 t of conventional scrap, which will be recycled in authorized plants.
- Minor quantities of hazardous and toxic products, which will be treated at authorized plants.

Analysis of these figures shows that contrary to what is normally thought, only a small percentage of the materials arising from decommissioning need to be treatment as radioactive waste.

2. TYPES OF DISMANTLING MATERIALS

Among the main activities to be performed during dismantling of the Vandellós I NPP are the disassembly of various systems, mostly without radiological implications, the demolition of many of the buildings housing these systems and subsequent release for conventional use of some of the buildings and of 80% of the land currently making up the site.

As a result of these activities, a large volume of waste materials will be produced. It will be necessary to condition and characterize these materials and where appropriate, dispatch them selectively and depending on their nature.

The three major groups of materials generated during dismantling are as follows:

1. **Conventional materials,** from areas without radiological implications (conventional intervention units).

2. **Radioactive Wastes**, from radiologically active areas (radiological intervention units).

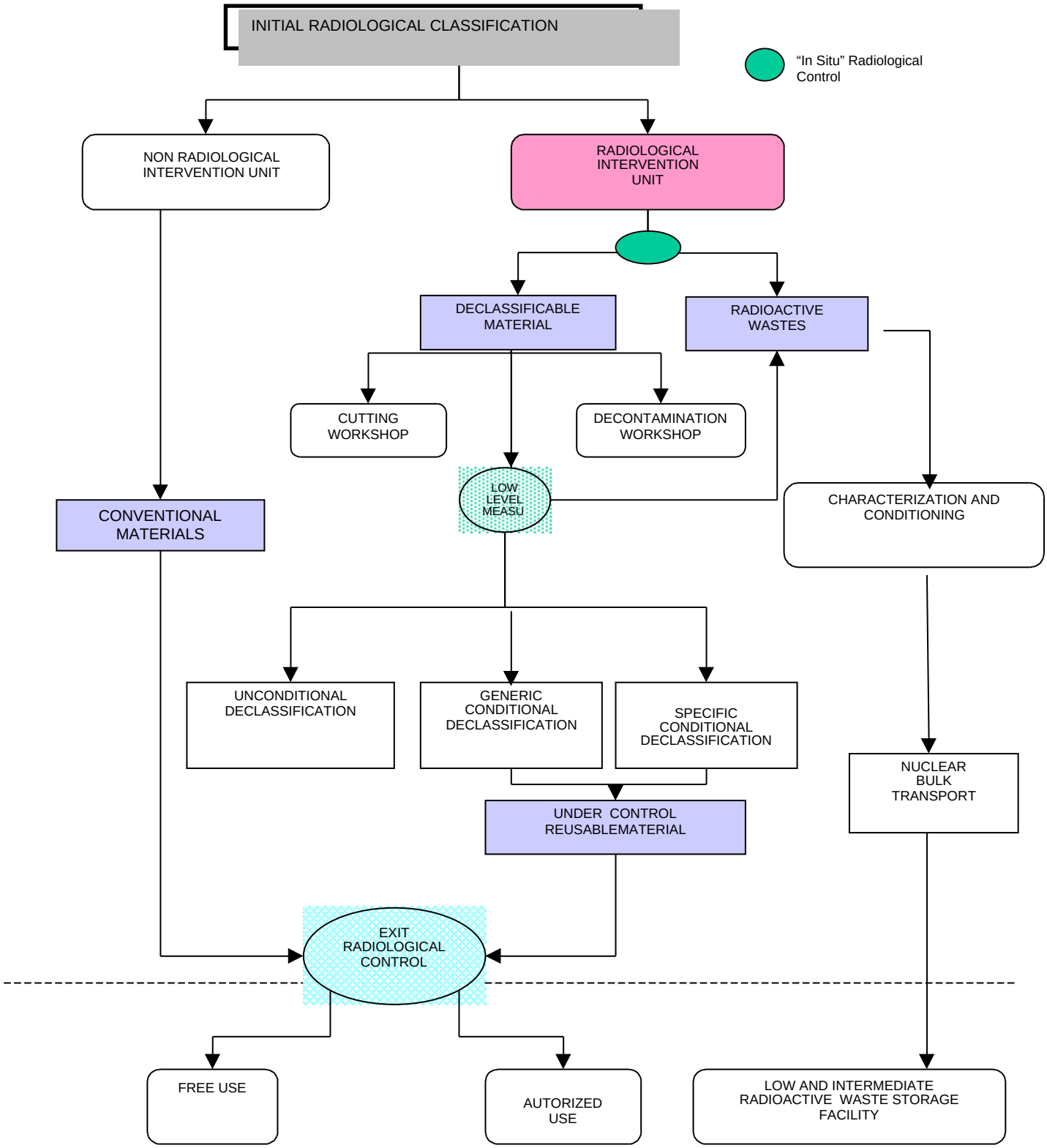
3. **Declassifiable materials**, also from the radiological intervention units and made up of items which in view of their operational and radiological background, the radiometric studies performed at the plant and the characterization carried out during this assembly are candidates for management as conventional materials with or without restrictions. In this respect, the materials must have levels of activity below those authorized by the regulatory body (Nuclear Safety Council - CSN)

   In this document, the term "declassifiable material" is used in the widest sense and encompasses not only the by-products of dismantling of the systems installations but also the remaining buildings.

   The graph on the following page summarizes the management routes for each type of material.

   As may be observed, the first classification determines the origin of the material. Thus, materials from non-radiological intervention zones are considered to be conventional while those coming from radiological intervention zones may be either radioactive wastes or declassifiable materials (potential candidates for declassification). Accurate characterization of the declassifiable materials may allow them to be declassified either for free reuse (unconditional declassification), conditioned for highly specific previously established uses (generic conditional declassification) or conditioned for particularly strict use following a case by case study (specific conditional declassification).

   The rest of the document describes in greater detail the model sketched here, detailing how this theoretical model is put into practice, what activities are required, who is responsible for their performance, what reference levels need to be met, etc.


INITIAL RADIOLOGICAL CLASSIFICATION
"In Situ" Radiological Control
NON RADIOLOGICAL INTERVENTION UNIT
RADIOLOGICAL INTERVENTION UNIT
DECLASSIFICABLE MATERIAL
RADIOACTIVE WASTES
CUTTING WORKSHOP
DECONTAMINATION WORKSHOP
LOW LEVEL MEASU
CONVENTIONAL MATERIALS
CHARACTERIZATION AND CONDITIONING
UNCONDITIONAL DECLASSIFICATION
GENERIC CONDITIONAL DECLASSIFICATION
SPECIFIC CONDITIONAL DECLASSIFICATION
NUCLEAR BULK TRANSPORT
UNDER CONTROL REUSABLEMATERIAL
EXIT RADIOLOGICAL CONTROL
FREE USE
AUTORIZED USE
LOW AND INTERMEDIATE RADIOACTIVE WASTE STORAGE FACILITY

3. MANAGEMENT OF MATERIALS DURING DISMANTLING

One of the fundamental objectives of dismantling is to guarantee that materials are adequately managed, clearly separating those which are contaminated from those which are not. In this respect, dismantling work has been grouped into the four following functional areas, which are in charge of putting into practice the theoretical model described in the previous section:

- Production and decontamination.
- Declassification.
- Management of conventional and declassified materials.
- Management of radioactive wastes.

These areas, which are represented on the graph on the following page, in different colours, correspond to different materials processing centres.

Treatment of the materials begins with the so called production phase or area, in which the materials are disassembled, cut up, decontaminated if required and packaged into homogeneous batches.

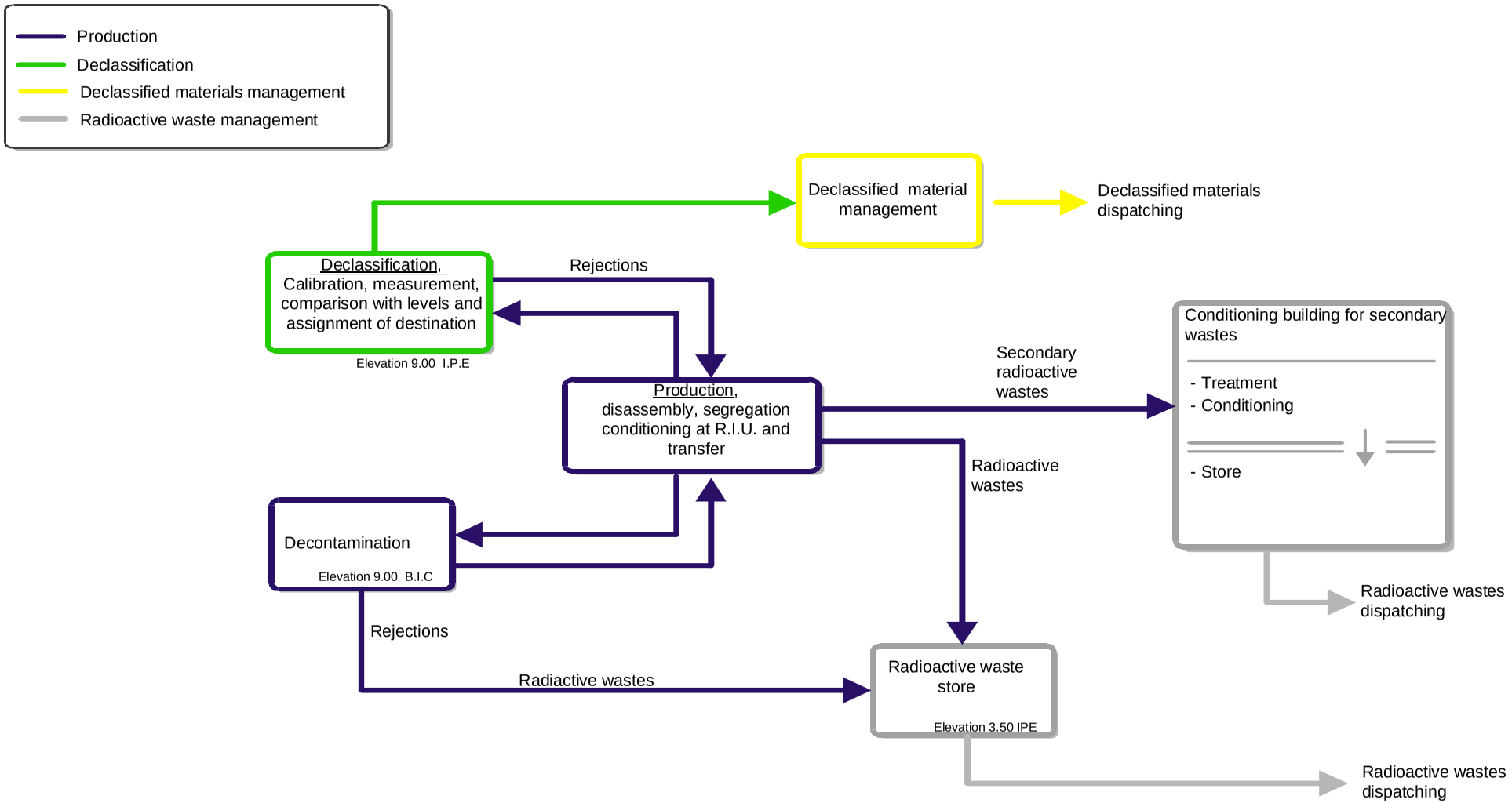
Once appropriately classified these batches are sent either to the radioactive waste management area or to declassification. If it is confirmed that the material meets the criteria established for declassification, it passes form here to the declassified materials management area.

The work performed during each of these phases or areas is multidisciplinary in nature and generally involves various organizational units or departments: Performance, Operations/Maintenance, Radiological Protection and Safety, Materials Control, etc.

Likewise, each area is associated with a specific physical place of work with the material being transferred via previously established routes.

The main activities performed at each of these areas are as follows:

DISMANTLING PROCESS



Activities begin in this area with the planning and analysis of intervention in the radiological zone from the technical point of view and in relation to safety and operations (tag-outs). Once the intervention has been authorized, activity continues with the disassembly, segregation and conditioning of the materials into handling units or batches (HU). In view of their complexity and the amount of work involved, these activities constitute the central core of production.

If the materials are candidates for decontamination and if this allows their subsequent treatment to be optimized, the decision might be taken to perform this work either in the decontamination workshop or "in situ", on the equipment or walls.

The following three controls are implemented in order to channel each material along the most suitable management route:

- The historic operating background of the installation is reviewed, this allowing to know, prior to the initiation of disassembly, those areas in which there are systems with radiological implications.

- The radiometric studies performed on site are reviewed on the basis of a total 7000 direct measurement, these studies have allowed a detailed radiological map of the plant to built up.

- Direct radiological measurements are performed on the equipment to be disassembled: Levels of α and β/γ surface contamination and dose rate on contact (for moving elements) or at 1 m (for fixed elements).

On the basis of the above, the material is initially classified and is assigned a type isotopic identification. The material is then transferred, appropriately conditioned, to the following process centre. The possible destinations for these materials are conventional waste management, if the material comes from non-radiological intervention units, radioactive waste management, if the material has been considered as such (primary or secondary) or declassification if the material has been typified as being declassifiable.

Special attention should be paid to the materials considered to be declassifiable since, in addition to meeting the radiological criteria, due to their being below the levels of activities authorized, they must be segregated in accordance with the physical conditions imposed by the declassification process to which they are subsequently to be subjected. In this respect, to the material batches (HU's) are required to be homogeneous:

- In nature and physical status:
  - Metallic solids (steel, aluminium, etc) and non-metallic solids (concrete, plastic, etc.)
  - Liquids (sludges, oils, etc).
- From the geometric point of view:
  - Apparent volume (small, large, wide, etc)
  - Accessibility
  - Weight/surface ratio

The main methods of conditioning the materials for transport and handling (HU's) are as follows:

- 220l drum, for both solids and liquids.
- Metallic container for high density solids (CMD and CMT).
- Big-bag, for low density solids.
- Specific large volume, very high density transport packages.

Prior to being transferred to the next treatment area, all materials packages are labelled and documented by means of the corresponding docket.

3.2. Declassification

Materials from radiological areas which have not been considered to constitute radioactive wastes are required to go through a process of declassification with two fundamental conditioning factors: the authorized

declassification levels, which they cannot exceed and the available measuring techniques which, with their limitations as regards isotope detection capacity, speed, sample size, etc. must be capable of determining the level of activity with a suitable degree of confidence.

The following techniques are currently available for materials characterization:

- Portable surface contamination meters
- ISOCS portable gamma spectrometer
- BOX-COUNTER gamma spectrometer
- CIEMAT gamma spectrometer
- MAB total gamma meter

The last two of these resources may be used for the characterization only of very small, very low weight parts. Consequently, in practice, the ISOCS and BOX COUNTER gamma spectrometers and the surface contamination meters are the most appropriate devices for large scale continuous characterization such as that required for this dismantling process.

The estimated masses and/or surfaces (as applicable) of potentially declassifiable materials are as indicated bellow:

TABLE 1.1. ESTIMATE OF DECLASSIFIABLE MATERIAL
(No OF CONTAINERS AND SURFACES)

GEOMETRY	DRUM (0.3 t / drum)	CMD (2 t / CMD)	SURFACE (m^2)
FERROUS SCRAP		1845	13500
NON-FERROUS SCRAP		75	
THATCH			22250
CONCRETE	100	30	60500
INSULATION		46	
CABLES		96 (Cu) 42 (Al)	
PLASTICS		4	
OTHERS			4000
TOTAL	**100**	**2106**	**100250**

The activities involved in the declassification process begin with reception of the materials and checking that they meet all the requirements necessary for characterization using the available measuring techniques.

Following this first control, the materials are radiologically characterized using the equipment most appropriate for each material type (BOX COUNTER for metallic containers and drums, ISOCS for walls, PORTABLE INSTRUMENTATION for specific parts or items, etc.)

Once the activity of the measurable isotopes has been obtained, the activity due to non-measurable isotopes is calculated and the total activity is obtained on the basis of the type isotopic identification[1] assigned to each material batch.

On the basis of the above, a destination is appointed to each batch of material in accordance with the limitations imposed by the authorized levels for declassification. A declassification certificate is issued and the document file is closed.

[1] The isotopic identification establishes the radionuclides present in each system or function to be disassembled along with the proportions of easily measurable radionuclides to non-measurable radionuclides.

If the materials have been declassified they are transferred to the materials management area, otherwise they are returned to the production area for a more intense decontamination process or for dispatch to radioactive waste management.

There are three possible levels of declassification:

- Unconditional declassification which allows for the unrestricted reuse of materials having a radioactive content of less than N_1, where N_1 may take the following values:

Mass activity for Beta/gamma emitters	0,2 Bq/g
Mass activity for alpha emitters	0,04 Bq/g (0,1)
Total Beta/gamma surface contamination	0,4 Bq/cm^2
Total surface contamination for beta/weak gamma emitters	4 Bq/cm^2
Total alpha surface contamination	0,04 Bq/cm^2 (0,1)

- Generic conditional declassification which allows for the reuse of materials with previously established restrictions, when the materials have a radioactive content below a given level N_2.

- Specific conditional declassification which allows for the reuse of materials having a radioactive content below a given level N_3, with restrictions to be established and authorized on a case by case basis.

This process of measuring and classifying the materials constitutes the fourth control in the materials management process.

3.3. Management of declassified/Conventional materials

Batches of material catalogued as declassified in the previous area are transferred to this area for temporary storage and subsequent dispatching to authorize destinations in accordance with procedures set up for this purpose.

Conventional and unconditionally declassified materials leave the site without any restriction on use. The only requirement to be met being those of the applicable legislation for industrial wastes which includes the need to draw up a "waste acceptance docket" between Enresa, as the producer, and the organization in charge of managing the waste.

In addition, each transport process offsite entails the drawing up of a waste tracking sheet which accompanies the vehicle and ensures the transport is performed under safe conditions.

Prior to such materials leaving the site the fifth and last radiological control is performed on the materials, this consists of having the truck pass through a large surface gate detector which verifies the non existence of radioactive material.

3.4. Management of radioactive wastes

The materials catalogued as radioactive wastes in the production area, both primary and secondary wastes, are conditioned in metallic containers (CMT's) or in drums.

Following radiological characterization, these containers are transported from the intervention units along clearly defined routes to the radioactive waste deposits, set up for this purpose, where they are stored pending transport to the El Cabril low and intermediate level radioactive waste storage facility.

3.5. Process documentation

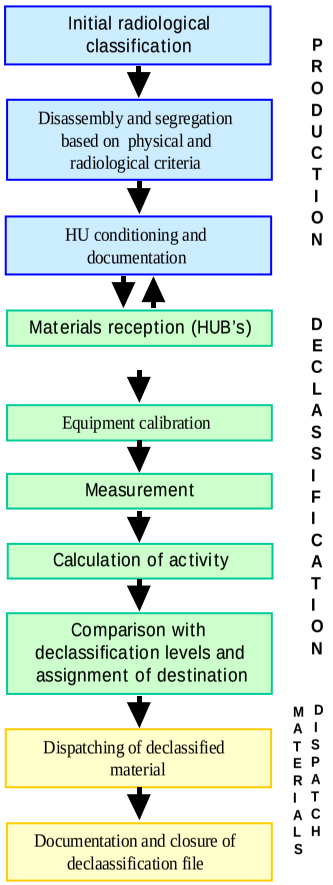
All the batches of material treated during dismantling are identified and documented by way of a docket created for this purpose and reflecting the main characteristics of each such batch:

- System of origin
- Material type
- Physical characteristics (weight, dimensions, etc.)
- Radiological characteristics
- Intermediate and final materials classifications
- Etc.

This information is also recorded in a materials management information system which makes it possible to know at each moment in time the total materials managed by each intervention unit, their characteristics, location on site, etc.

4. FINAL SUMMARY

As a summary of the process described, the graph on the following page shows the main activities involved in the materials management and declassification process, indicating in each case, the organization responsible for performance.



PERFORMANCE	RADIOLOGICAL PROTECTION	OPERATION AND MAINTENANCE	QUALITY ASSURANCE	MATERIALS CONTROL
➡ Creation of a HU's, in accordance whit physical and radiological requirements. ➪ HU documentation.	➚ Radiological characterization of materials on the basis of historical knowledge,the radiometric study and in situ measurements. ➶ Declaration of destination of HU.		⑨ Inspection of HU creation process.	❼ Coordination of materials movements.
	➪ Calibration of measurements systems . ➪ Measurement and calculation of activity. ➪ Verification of measurement process. ➪ Comparison with declassification levels and assignment of destination.		❨ Inspection of measurement process.	➚ Materials reception (HU's). ➡ Verification of production and measuring systems prerequisites. ✣ Documentation and data recording.
		➚ Conditioning. ➡ Documentation and dispatch to authorized destination.	➪ Inspection of dispatch.	➪ Documentary closure of file.