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LONG TERM MANAGEMENT STRATEGIES FOR RADIOACTIVE WASTE GENERATED DURING ACCIDENTS AND INCIDENTS

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ABSTRACT

This paper summarizes the radiological incidents occurred in the Spanish non nuclear industry in the last few years and their consequences. The paper focuses on long term management problems, explaining the criteria used in contaminated sites clean-up, the requirements for waste packaging, the urgent need for interim storage capacity to get unregulated areas rid of radioactive materials, an the strategies set to minimise the final volume to be disposed of at El Cabril Near Surface Disposal facility and to develop an specific disposal facility for waste with very low activity.

1. INTRODUCTION

In March 30 1998 a Caesium-137 radioactive source was melted in Southern Spain. The incident was not immediately detected nor reported to the Nuclear Safety Council (CSN). In June 10, the CSN sent inspectors to the sites to get control of the situation, backed by experts from ENRESA, the Spanish organisation in charge of radioactive waste management. As a consequence four major sites were contaminated, including: A steelyard in Cadiz Province; a Hazardous Waste Treatment Plant, where Electric Arc Furnace Dust (EAFD) was sent for stabilisation, in Huelva Province; the disposal site where the stabilised waste, once classed as inert, was dumped, also located in Huelva Province; and a Metallurgical Demonstration Plant where EAFD waste was sent for recovery of some metals

Figure 1 shows a flow diagram of the incident

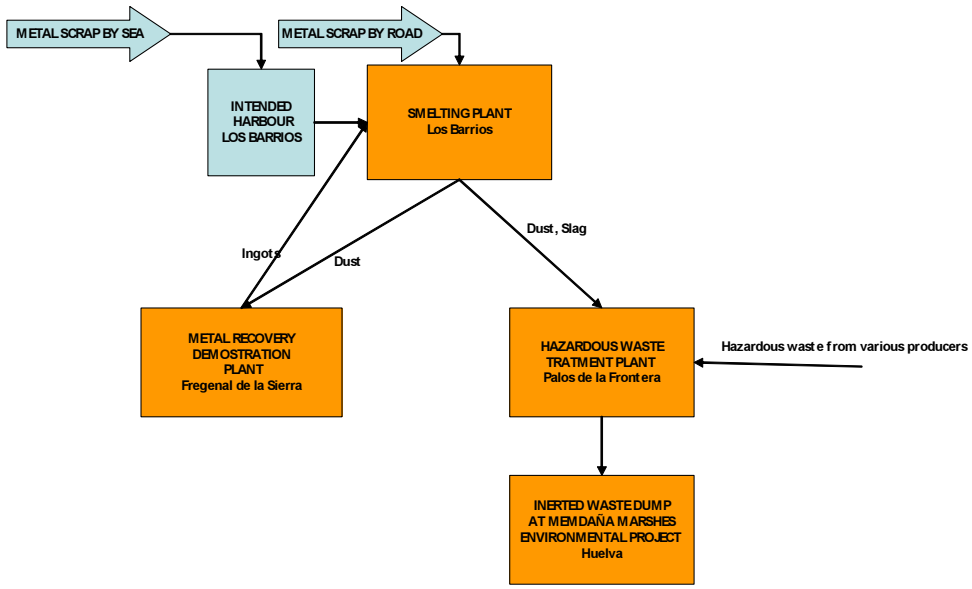

Figure1. Flow diagram of a Cs-137 melting incident in a steelyard in Southern Spain

The airborne activity was also detected in France and Italy, but was not detected, or activity increases were insignificant, in Spanish Radiological Surveillance System, as well as in Gibraltar, near to which the steelyard is located.

2. EARLY ACTIONS AFTER THE INCIDENT

Early actions included Surveillance of Personnel, of nearby areas and a radiological characterisation of the affected sites. Most of the contamination was in the EAFD collected in hose filters and resulted in contamination of thousands of meters cube and four sites affected with plant outages and enormous clean-up costs and waste management costs. Once the CSN inspectors had control and verified the radiological risk, the plants were shutdown. They investigated the origin and sequence of the incident. Likely the origin was a load of imported scrap transported by sea from the US or Europe. The activity of the source was estimated in 120 Ci.

The consequences were limited in terms of doses to the workers (classed as public) or the environment, and the CSN defined clean up objectives, that can be summarised as follows:

- to be performed with personnel professionally exposed to ionising radiation;
- under the control of a Radiological protection specialised company
- with a residual objective of < 1 mSv/y
- Below that constraint, application of the optimisation principle

CSN also urged the Ministry of Industry to request the site operators an Action Plan for clean up and waste management.

ENRESA issued specific waste acceptance criteria, mainly directed to transport, interim storage and preparation for conditioning and final disposal. Transportation, storage and final disposal was under ENRESA's responsibility.

Additionally ENRESA signed co-operation agreements with all the operators for assistance in waste minimisation. ENRESA assisted to the management of clean-up in three of the affected sites, including the position of radiological protection unit in the case of Mendaña (inert waste disposal site), where a larger potential contamination was estimated.

One of the problems of the time was the absence of predefined criteria and the need of definition of responsibilities. The diagram of figure 2 shows the scheme of actions established in an early period.

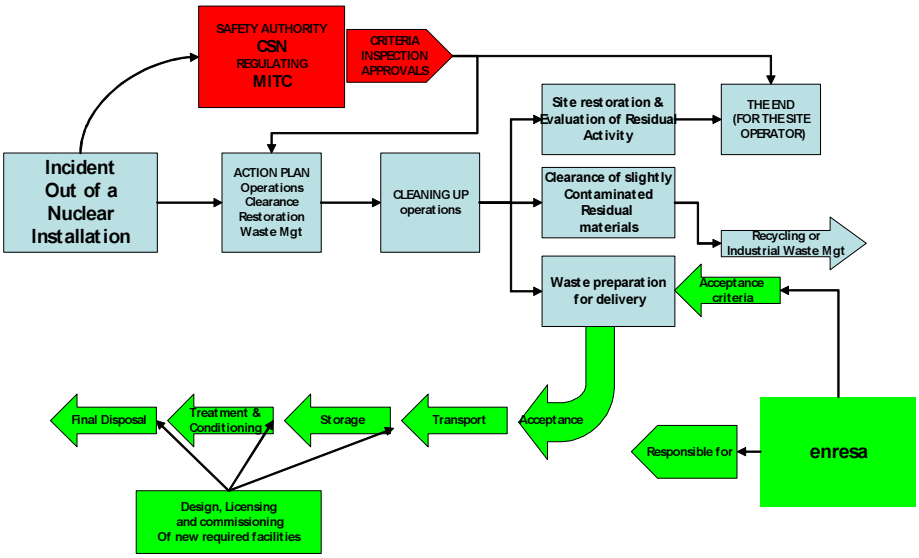

Figure 2. Simplified scheme of post incident actions

All the site operators prepared their Action Plans, adopting derived values for residual dose rate (10 µSv/h) and surface contamination (4 Bq/cm^2) and performed the decontamination work. In the case of Mendaña, where the activity was scattered, after the removal of the material with a higher concentration, a remedial action was later implemented with the same dose objective. This remedial action is described in a different paper of this Technical Meeting (1).

3. OTHER INCIDENTS. WASTE AMOUNTS AND TYPES

In addition to the above described incident other three relevant incidents happened in the following years, even if a preventive protocol was signed between the main actors in the metal industry and Radiological Protection. The experience of its application is summarised in references (1) and (2).

Table 1 shows a summary of the four incidents reported in this paper and their consequences.

Table 1. Incidents in the Spanish industry and their consequences

Incident	Affected sites	meters cube of waste	Activity of the source
Los Barrios	Steel yard; Hazardous waste treatment plant; Inert waste disposal site; Metallurgical Plant	1992	
Alcala	Steel yard; Hazardous waste disposal	323	100 GBq (2,7 Ci)
Gijon	Scrap Dealer and Shredder	72 m^3	7,8 GBq (0,2 Ci)
Sestao	Steel yard	73 m^3	1,7 GBq (0,05 Ci)

Most of the waste received is EAFD or the inert waste produced by EAFD and other cross-contaminated hazardous waste stabilised to get an inert matrix. All these materials are packed in big-bags, and when externally contaminated plasticised.

4. WASTE MANAGEMENT

4.1 Short term actions

The waste produced in the incidents have been transported by ENRESA to El Cabril disposal facility, in Cordoba, but this Nuclear Installation needed a modification of the operating licence, written for waste from nuclear and radioactive installations.

The available storage room was clearly insufficient and thus, in addition of the existing place, a provisional interim storage was built. The primary waste packages were metallic boxes and big-bags with dust and cemented waste. The drums and metallic boxes could be directly conditions and re-packed for disposal, but waste in big-bags needed a definition of the conditioning process and a definition of its disposal.

4.2 Disposal as LILW inside concrete containers

One prime objective in ENRESA has always been to optimise the use of the limited space existing for final disposal at El Cabril. Most radioactive waste packages are 220 litres drums that are re-conditioned inside 11 m^3 concrete containers, and then backfilled with cement grout. For this reason a good idea seemed to be the use the space of the backfilling grout to condition the EAFD contaminated waste.

A R&D project was launched to verify the feasibility of this process. This R&D project has shown the good properties of the designed mix, but recommended in a part of the waste the separation of chlorides in the waste. A Chloride reduction system had to be developed from laboratory tests, to pilot plant, also intended to check the workability of the mix, and finally the industrial size system

Also a new building design was launched to provide medium term storage and to install at El Cabril new capacities for potential future needs, taking into account that local construction permits, granted by local councils might be the critical path for a new facility in case of necessity.

4.3 Disposal as Very Low Level Waste

As a consequence of these incidents, the there is an increase of the social understanding and acceptance and the awareness of political representatives of the risks and the difficulties of managing radioactive waste and materials with slight residual activity in places out of the nuclear regulations.

After the reports from the CSN to the Spanish Parliament, all the political groups represented in the Commission for Industry of the Parliament urged the Government to develop an installation specifically intended for very low activity waste (3). This facility is now under construction after a long procedure, with Environmental Impact statement, local permit and Execution Authorisation processes. The Execution Authorisation was granted by the Ministry of Industry, after report from the CSN on February 2006. The end of the civil works is planned by the end of November 2007.

The proposed specific activity limit per package is given in table 2.

Table 2 Proposed limits for very low activity waste packages

NUCLIDE	T½ (y)	Bq/g
H-3	1,24 E+01	10000
C-14	5,73 E+03	10000
Ni-59	7,50 E+04	10000
Co-60	5,27 E+00	100
Ni-63	9,60 E+01	10000
Sr-90	2,91 E+01	10000
Nb-94	2,03 E+04	100
Tc-99	2,13 E+05	10000
I-129	1,57 E+07	10000
Cs-137	3,00 E+01	300
Pu-238	8,77 E+01	100
Pu-239	2,41 E+04	100
Am-241	4,32 E+02	100
Pu-241	1,44 E+01	10000
Cm-244	1,81 E+01	100
U-235	7,04 E+08	1000
U-238	4,47 E+09	1000
U-234	2,45 E+05	1000

The disposal system (4) is based on the European Directive applicable to the elimination of hazardous waste. Figure 3 shows a scheme of the barriers adopted for this category of waste. The lower barrier is a clay layer of 1 m complemented with 3 cm of geo-bentonite, providing an equivalent thickness of 5 m of clay with hydraulic transmisivity lower than 10^{-9} m/s. Above this layer, the directive requires a High density polyethylene (HDPE) film and a leachate collection system. In El Cabril case, this HDPE film and leachate collection are double to give additional safety and surveillance of the system.

The waste are protected from the weather by means of a light roof installed in the working zone. This roof is moved to an adjacent position once a zone has been filled up with waste.

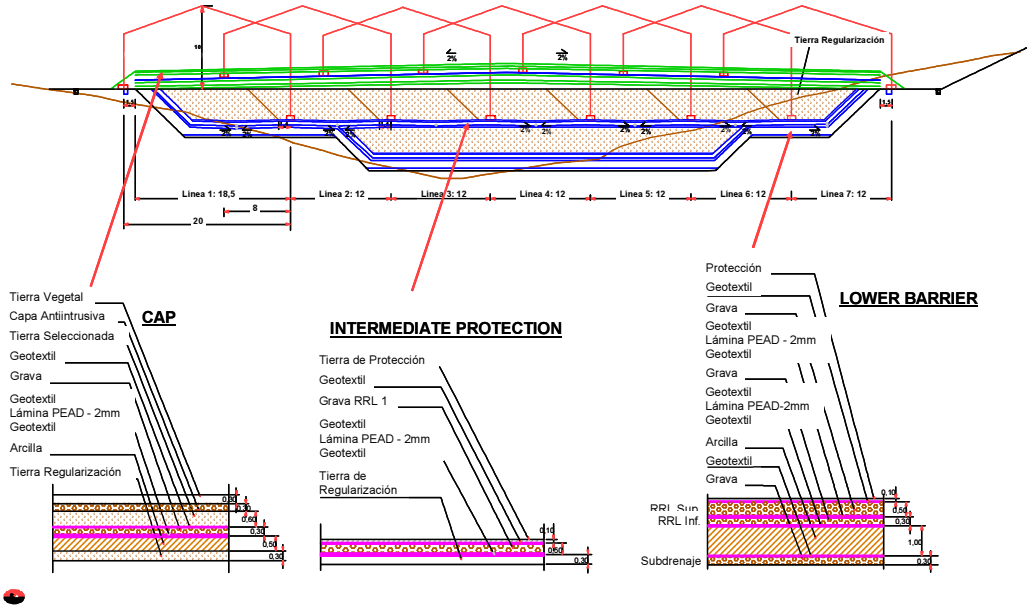

Figure 3. Scheme of the VLLW disposal system at El Cabril

5. CONCLUSIONS

The occurrence of radiological incidents in the Spanish metal industry did not present relevant doses to the public or the workers. However, unplanned waste arising was a challenge for the Spanish waste management system.

A rapid response from the CSN and the Ministry of Industry, and the support of ENRESA contributed to minimise risk and limit the impact on the amounts of waste to deal with.

Interim storage capacity has to be considered as a key aspect, in order to quickly get non regulated areas rid of radioactive waste, while providing time to carefully plan the long term management of the waste.

Recovery of large amounts of materials from land with residual contamination may appear as not practicable. In situ remedial actions and criteria and procedures for surveillance are thus necessary.

Measures have been implemented to minimise additional needs of final disposal volume, but these measures may be time consuming. On the other hand, these incidents have contributed to the social understanding of the need of a safe and reliable system to deal with long-term management of radioactive waste and have helped to implement the Very Low activity Waste disposal facility

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