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REVISION HISTORY

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02	Addition of CCI (PROTECT-COMMERCIAL) markings	28-06-2008
03	PCSR June 2009 update: – Clarification of text – Clarification on use of metallic zinc and aluminium.	26-06-2009
04	Consolidated Step 4 PCSR update: - Minor editorial changes - Material 20 MND 5 introduced as possible steel selection	26-03-2011

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SUB-CHAPTER 6.1 - MATERIALS

1. METALLIC MATERIALS

Metallic materials used for the pressurised equipment in the nuclear island comply with specifications defined in technical codes[1] and take into account the essential safety requirements contained in both conventional and nuclear regulations. For large non-pressure components, the materials used also comply with technical codes, e.g. RCC-M requirements apply to the Reactor Pressure Vessel (RPV) internals and component supports (see Sub-chapter 3.8).

The technical specifications define the requirements in terms of:

- Chemical composition,
- Manufacturing process,
- Mechanical properties,
- Testing.

These requirements allow materials to comply with objectives for their behaviour, taking into account their foreseen use (e.g. limitation on irradiation embrittlement for the Reactor Pressure Vessel (RPV) materials)

A basic principle for the selection of materials for the PWR is to use proven and successfully tested materials and to use the same manufacturing processes. At this stage of the project, with some exceptions (see below), all materials planned for use in the EPR are currently used on French or German operating plants.

For example, the main materials used on primary components are: 16MND5 (on RPV), 18MND5 or 20MND5 (on steam generators and pressuriser), alloy 690 (on steam generator tubes), Z2 CN 19-10 + N_2 (on main coolant lines), Z3 CN 20.09 M (on reactor coolant pump casing).

Nevertheless, some new materials are being developed or used e.g.:

- in order to reduce the use of stellite (very hard based cobalt alloy) as hard facing material in the primary circuit components (e.g. valves, reactor vessel internal components). Following qualification, these materials could be implemented to reduce the radioactive inventory in the primary circuit, particularly cobalt 60, which is formed by the activation of cobalt and is one of the main contributors to radiation doses (see Chapter 12 - Radiological Protection). In addition, there is a more wide ranging requirement defined in the regulations to reduce the cobalt content in any alloys used for components directly in contact with primary fluid (this provision is an ALARP measure).

[1] This includes nuclear codes, conventional codes and harmonised standards that meet the statutory requirements.

- for the main steam lines of the VVP [MSSS], a grade of steel with optimised mechanical properties and toughness has been selected (P355NH). The objective is to use a grade of steel with existing industrial applications (grade requested by European standard EN 10216, for example, for tubes without welds and available in steelmakers' catalogues) whilst remaining close to the previous, well-known, grade of steel (P280GH) in order to limit the risks associated with the change (weldability etc.). The selected material also meets additional requirements relating to the level of inclusions and mechanical characteristics. Also, the aluminium content of this steel limits the risk of dynamic aging after deformation (killed steel). Consequently, the selected grade of steel ensures robustness and toughness and eliminates the risk of fast fracture, providing adequate margins for the demonstration of "Break Preclusion" for the main steam lines inside and outside of the reactor building (see Sub-chapter 10.5).

In principle, several materials qualified in the construction code may be suitable for a mechanical component. In some specific cases where a component is identical to one on an operating power plant, then the same material and manufacturing process are used even if it is not yet included in the RCC-M code.

For example:

- martensitic stainless steel is used for part of the EPR control rod drive mechanism, (RGL [CRDM]) pressure housing (used in the Konvoi design),

- stabilised austenitic stainless steel is used for parts of the EPR RGL [CRDM] pressure housing (used in the Konvoi design where low carbon steels are not used).

Generally, for austenitic steel pressurised equipment, "low carbon" austenitic steel is used as it is proven and has been successfully used in French PWRs. In general, stabilised austenitic steels will not, therefore, be used as this avoids welding problems between low carbon steels and stabilised steels. Nevertheless, if stabilised steels need to be used for specific parts of the plant (proven in existing installations), then a specific justification will be provided (e.g. on some parts of the pressure housing of the RGL [CRDM]).

All of the materials which, on contact with their environment in normal or accidents situations, produce chemical products that are likely to burn, explode or present other hazards, are prohibited or their use is subject to rules defined on a case-by-case basis. For example, metallic zinc and aluminium are generally prohibited or very strictly limited if they are not protected from containment spray (EVU [CHRS]).

Quantities of materials (and impurities that they contain) which may contribute to an increase in the radioactivity of the primary cooling system are limited as far as possible.

2. NON-METALLIC MATERIALS

No standard requirements exist for non-metallic materials. Such materials are discussed in other chapters of the PCSR as appropriate.