

ADDITIONAL CONSIDERATIONS

- *About extensive use of passive safety*

In the past the nuclear plants' complexity increased very much, mainly as a consequence of the introduction of safety and redundant systems.

Nevertheless, the exasperation of the complexity of a plant system may not always be the best solution of the problem of the safety guarantee.

In fact, the complexity may cause the invalidation of two aspects representing the essence of the "inherent safety" of a plant: its reliability and simplicity.

- ***About plant lifetime***

MARS plant life time is of the order of one hundred years, so much longer than in traditional PWRs.

This is a consequence of the low neutron irradiation on the reactor vessel and of the low operating temperature which guarantees a high reliability of steam generator tubes (reactor vessel irradiation is one of the limiting factors for plant lifetime in nuclear power plants).

In addition, the non-traditional mechanical design allows the easy disassembling, and substitution if necessary, of all activated components, including reactor vessel and steam generator tube bundle.

- *About MARS containment building*

The Mars reactor plant is equipped with a pressurized containment filled with pressurized water enveloping the whole primary loop (CPP – pressurized Containment for Primary loop Protection).

The plant is also equipped with a containment building to face external events in accordance with Italian and European regulations (aircraft impact, tornado, explosions, etc.).

The need to face these external events make the containment building able to withstand any internal pressurization, also in the incredible event of a complete destruction of the core coolant boundary.

- ***About accidents made impossible in the MARS plant***

LOCAs are eliminated thanks to the adoption of the pressurized containment of the primary loop.

As a matter of fact, in the worst accidents, the origin of the deterioration of the core cooling is a consequence of ruptures in the primary-coolant pressure boundary.

ATWSs are eliminated thanks to the adoption of the additional passive-type scram system

LOFAs are eliminated thanks to the adoption of the Safety Core Cooling System.

- ***About MARS capital cost***

In spite of the presence of the water-filled pressurized containment, that in the MARS concept is a relevant system, the plant investment cost is kept comparable with the one of the cheapest traditional nuclear plants, thanks to the huge plant simplification (drastic reduction of the number of systems and components), the reduction of components relevant to safety, the reduction of concrete volumes and the maximization of in-shop pre-fabrication.

The total direct investment cost, including contingencies, has been evaluated equal to about 1650 US\$/kWe (referred to a 3-unit, 450 MWe station).

On the other hand, the plant simplification also allows for a reduction of operation and maintenance costs, so the cost of electric energy produced (kWh) has been evaluated to be less than 3.5 US¢ during the debt period, to drop drastically to less than 1.4 US ¢ for a long life period thereafter.

- ***About required R&D activities***

MARS concept does not require substantial R&D activities.

All basic aspects have been deeply investigated both theoretically and experimentally.

Several experimental facilities have been realized to test behaviour and performance of the safety core cooling system.

Experimental activities to test behaviour and performance of additional passive-type scram system are going to be carried out.

- ***About required R&D activities*** ***(Cont)***

All components use well-proven technology.

No accessibility is needed for underwater components; all submerged components are flanged: even if they do not require maintenance, if for any reason the access to them is needed, they may be removed and easily maintained in dry condition.

As far as the seismic response is concerned, a full seismic analysis of the whole primary loop and of the enveloping pressurized containment was performed, together with dynamic analyses concerning pressurization/depressurization of the enveloping containment, showing that stresses meet requirements of design code (ASME code) and that any mechanical interference between the two fluid system components is prevented.

- ***Markets interested in MARS plants***

MARS plant seems to have many characteristics of interest for a market sector which includes small utilities and limited electricity networks (thanks to its limited size) as well as large utilities and extended networks (thanks to modularity).

On the other hand, the possibility of co-generation, allows to increase the overall plant efficiency and makes it appealing for a large number of applications.