# Comparison with bombs

A bomb differs from fuel on the time scale.
The difference is not the amount
of energy per kg (comparable)
but the time of release.

Since bomb fragments fly apart at
velocities of order 3000 m/s, energy
release stops in about 10μs
(the density of the explosive becomes
subcritical because the fragments separate)

# Bibliography


- Bernard L. Cohen American Journal of Physics, 55 (1987) pg.1076

*An excellent review of problems and comparisons*

- IAEA, Board of Governors, Post accident review-meeting, Gov. 2268, 16/09/1986

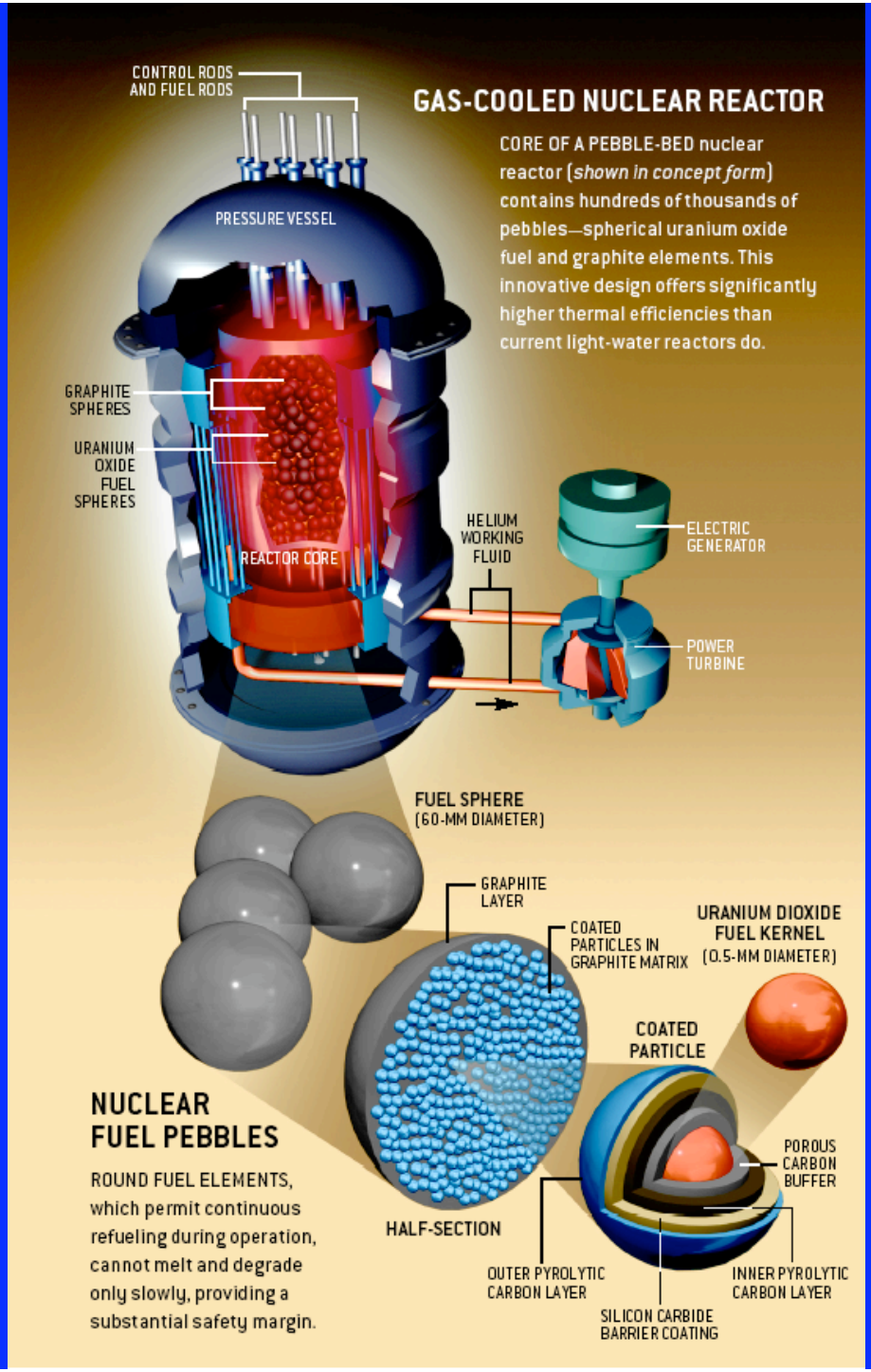
*Contains the detailed description of the accident at Chernobyl*

- APS Study Group (R. Wilson ch.) Rev. Mod. Phys. 57(1985) n°3, II part

*Contained warnings concerning safety on USSR reactors*

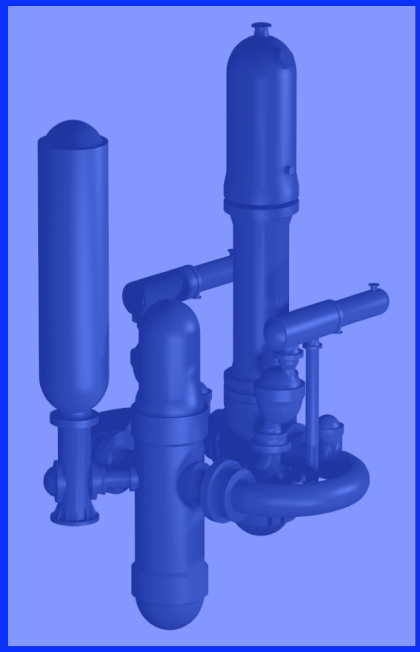
- General view: shttp://www.nucleartourist.com/

- Safety:http://users.owt.com/smsrpm/nksafe/nineties.html#05




# Gas-cooled nuclear reactor

# Multipurpose Advanced Reactor inherently Safe



***University of Rome "LA SAPIENZA"***
Department of Nuclear Engineering and Energy Conversions

# *MARS Main Design Objectives*

- UNAFFECTABLE SAFETY
- REDUCED COSTS
- EASY DECOMMISSIONING
- MINIMUM WASTE PRODUCTION
- LOWEST DOSES

# *Main Design Criteria*

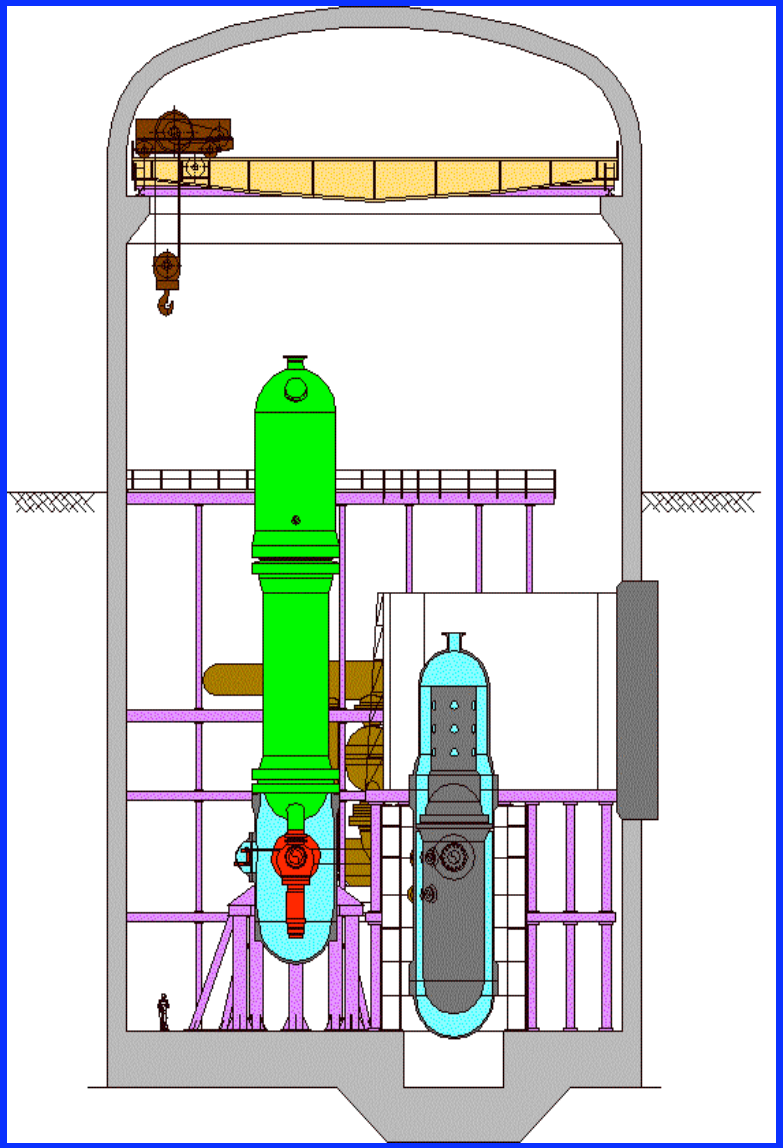
- MAXIMUM USE OF PROVEN TECHNOLOGY
- ADOPTION OF PASSIVE SOLUTIONS, AS FAR AS THE TWO CORNERSTONES OF NUCLEAR SAFETY ARE CONCERNED (*reactor shutdown and residual heat removal*)
- REMOVAL OF POSSIBLE PRIMARY-COOLANT BOUNDARY FAILURE
- PLANT SIMPLICITY
- REDUCED AND CERTAIN COSTS
- LOWEST RADIATION DOSES TO PERSONNEL
- LOW WASTE PRODUCTION

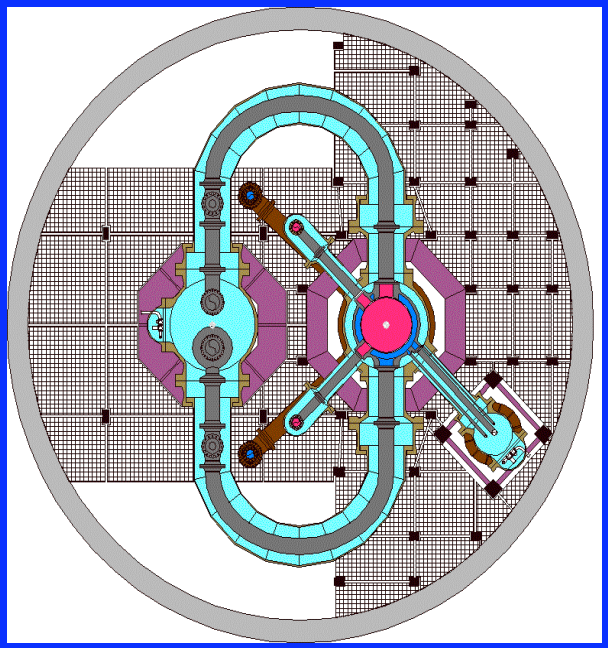
# Main Characteristics

THE MARS REACTOR IS A PRESSURIZED LIGHT WATER REACTOR. THE PRIMARY COOLING SYSTEM INCLUDES ONE LOOP ONLY, WITH A VERTICAL-AXIS U-TUBE STEAM GENERATOR.

| | |
|---|---|
| RATED POWER | 600 MWt |
| OPERATING PRESSURE | 75 bar |
| PRIMARY COOLANT FLOW-RATE | 3227 kg/s |
| CORE INLET TEMPERATURE | 214 °C |
| CORE OUTLET TEMPERATURE | 254 °C |
| FUEL RODS ARRAY | 17x17 |
| FUEL ASSEMBLIES | 89 |
| TOTAL CONTROL ROD CLUSTERS | 45 |

# MARS containment building





# *Severe accidents*

SEVERE ACCIDENTS IN THE MARS REACTOR ARE PHYSICALLY IMPOSSIBLE.

NEVERTHELESS, ACCIDENTAL SCENARIOS INCLUDING CORE MELTING HAVE BEEN TAKEN INTO CONSIDERATION AND THE IN-VESSEL CORIUM COOLABILITY HAS BEEN ANALYZED.

THE PRESENCE OF WATER IN THE PRESSURIZED CONTAINMENT ENVELOPING THE PRIMARY COOLANT BOUNDARY MAKES IT POSSIBLE TO ACHIEVE A SAFE IN-VESSEL CORIUM COOLING AND MAKES EVEN A SEVERE ACCIDENT COMPLETELY MANAGEABLE.

# Project Development Status

- The nuclear design of the core and of the reactivity control systems has been completed.
- The design of the primary coolant system has been completed.
- The design of the passive-type emergency core cooling system has been completed.
- The mechanical design of the additional, passive-type scram system has been completed.
- The design of main NSS auxiliary systems has been completed.

# *Project Status (cont)*

- The mechanical design of advanced solutions proposed for traditional components has been completed.
- The design and verification of the reactor building and internal supporting structures have been completed.
- The analysis of produced wastes has been completed
- The HAZOP Analysis and the Probabilistic Safety Assessment of the plant have been completed.
- The Safety Analysis regarding all nuclear accidents has been completed.
- The cost analysis of energy produced has been completed

# *Project Status (cont)*

- **The study of coupling of the NSS system to a co-generation scheme including desalination has been completed.**
- **The decommissioning program of the plant is going to be completed.**
- **Experimental activities have been performed to validate the main aspects of the design**

***A PRELIMINARY SAFETY ASSESSMENT REPORT HAS BEEN OFFICIALLY SUBMITTED TO THE ITALIAN NUCLAR SAFETY AUTHORITY***

# Annual solid wastes production ($m^3$)

## Annual solid wastes production ($m^3$)

| Type | Original production | Waste production after traditional conditioning | Waste production after advanced conditioning | Traditional PWRs with traditional conditioning (same power level) |
|---|---|---|---|---|
| resins | 0.65 | 1.3(1) | 0.05(4) | |
| filter cartridges | 1.7 | 1.9(1) | 0.32(5) | |
| compactable DAW | 7.5 | 1.4(2) | 0.45(5) | |
| non comp. DAW | 0.65 | 0.7(1) | 0.7(5) | |
| mixed wastes | 0.12 | 0.13(1) | 0.13(1) | |
| chemicals | 1 | 0.5(3) | 0.04(6) | |
| **total** | **11.62** | **5.93** | **1.69** | **20** |

(1) cask filling
(2) low-pressure compacting and cask filling
(3) neutralization and cask filling
(4) incineration and cask filling
(5) high pressure compacting and cask filling
(6) drying and cask filling

**Waste production**