PNRA Experience in Regulatory Oversight of Passive Safety Features used in K-2/K-3

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Introduction

Passive safety features are used in advanced (Gen-III) nuclear power plants to ensure safety of the plant in worst scenarios such as design basis accidents and design extension conditions . Passive systems do not require external power supplies, or human intervention for operation. These systems take the advantage of natural forces or phenomena such as gravity, pressure differences and natural heat convection.

Rationale to Use Passive Safety Systems

Potential for enhanced safety through increased safety system reliability

1

Achievement of enhanced safety goals

2

PNRA Preparation for Review

Facts
Not of safety class
Not part of normal operation

Proactive approach

In house deliberation on requirements

Reliance on Regulatory Review experience
IAEA documents, research papaer and case studies

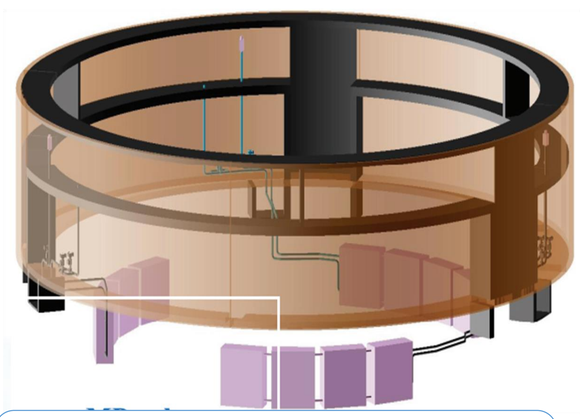
Key Areas of Review Emphasis

- Establishing the phase of flow fluid and special aspects like lack of data on some phenomena, missing operating experience over the wide range of conditions; and
- Small driving forces

Regulatory Issues in Review of Passive Systems

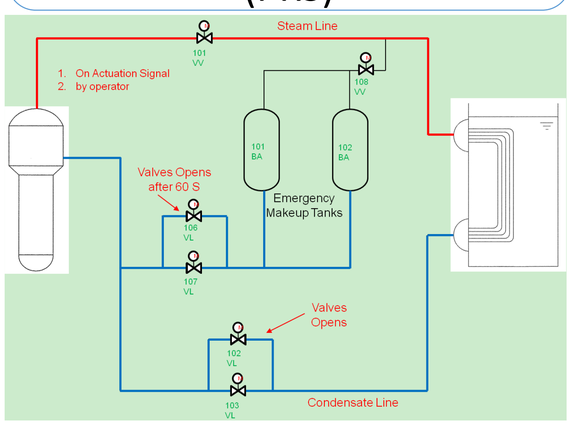
- Lack of guidance documents
- Lack of regulatory experience in regulating these features of NPPs
- Non-availability of national regulatory requirements
- Newly introduced concept of DEC and use of passive safety features

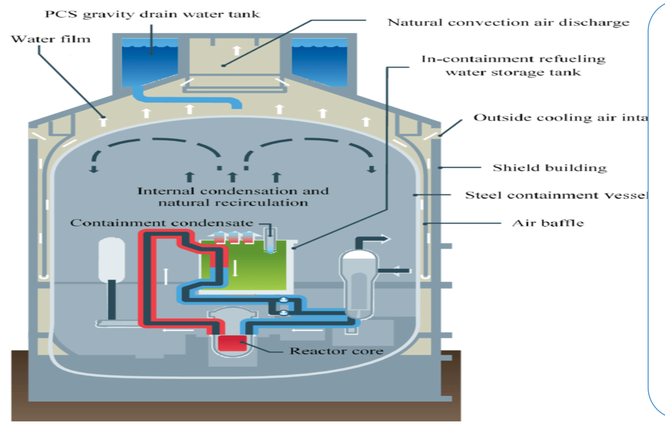
Significant Passive Safety Systems of K-2/K-3



Passive Containment Heat Removal System (PCS)

Passive Residual Heat Removal System of Secondary Side (PRS)

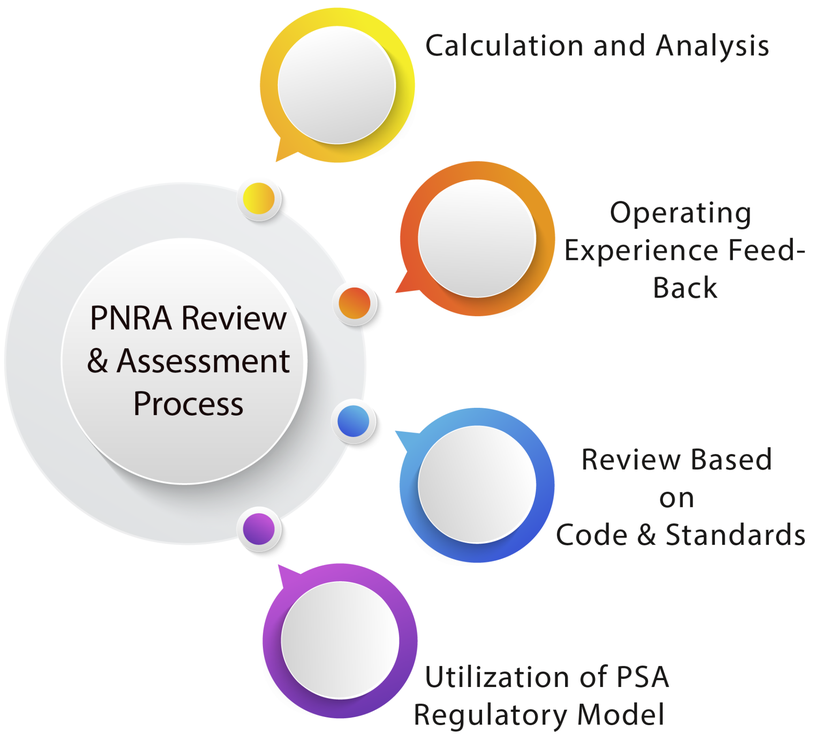




Reactor Cavity Injection and Cooling System (CIS)

Safety Case Review Focused Areas

- Design heat loads of the systems
- Capacities of heat exchangers
- Thermal siphoning
- Maximum flow during accident



FOAK Approach

Following reports were reviewed

- Heat transfer capability of PRS Verification test.
- Flow-induced vibration test of reactor vessel internals
- Natural circulation test of reactor coolant system
- Temperature and displacement monitoring of pressurize surge line
- First cool down functional test

Improvement in CDF

The licensee took credit of Passive Safety Systems to reduce CDF to 8*10-7 for K-series plants (a reduction of the order of two in comparison with generation II NPPs)

Conclusion

Advancements in nuclear front are being made and from large scale to small scale new modern and innovative NPP designs are being formulated. The advancements of safety features in the design of NPPs like inclusion of passive systems should be made known to public to build their confidence. NPPs as of now are the answer to green energy. The regulators must keep themselves at par with the international advancements. Capacity building, knowledge management are the key issues. A lot will be first of its kind in near future. We have to be prepared.