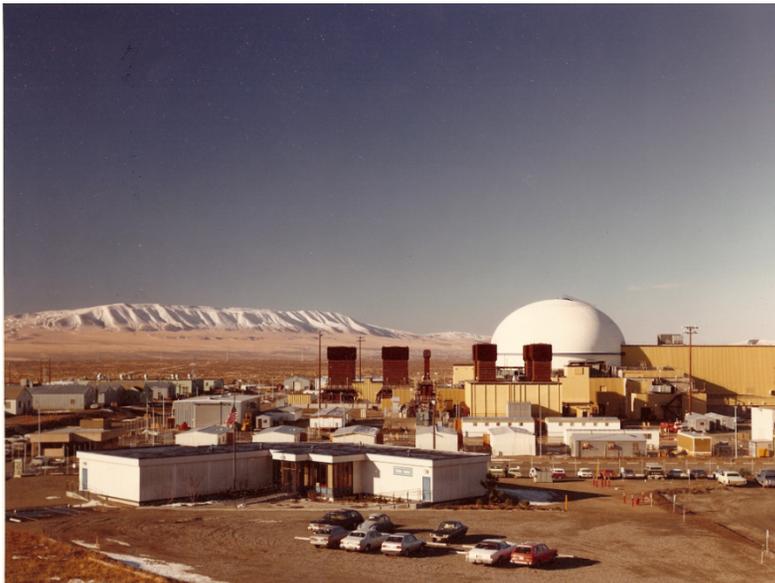




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Previous Experience “Licensing/Authorizing” Non-LWRs in the US— How It Was Done And Who Did What



**NRC-DOE Advanced Non-Light
Water Reactors Workshop
Rockville, Maryland**

**Dr. George Flanagan
Oak Ridge National Laboratory**

September 1–2, 2015



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Evaluation and Licensing of non-Light Water Reactors (LWRs) dates back to 1950s

- **The Atomic Energy Commission (AEC), the Advisory Committee on Reactor Safeguards, and after 1974, the Nuclear Regulatory Commission have a long history of evaluating and licensing of non-LWRs starting with Experimental Breeder Reactor (EBR I) in 1951-credited with the first significant power generation**
- **Nine gas-cooled reactor designs were evaluated or reviewed not counting the mHTGR or Next Generation Nuclear Plant (NGNP)**
- **Nine sodium-cooled reactor designs not counting PRISM/SAFR were evaluated or reviewed**
- **Numerous one of a kind research and test reactors were also evaluated or reviewed**
 - Power generation
 - Isotope production

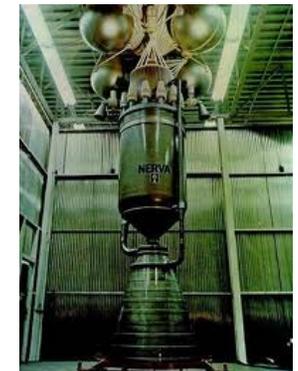
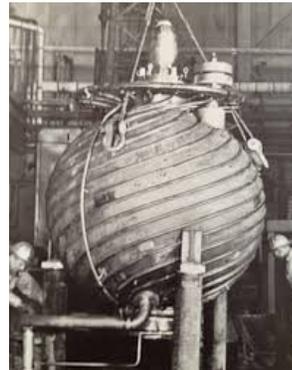


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AEC Licensed Several Other non-LWRs for Experimental Purposes

- NaK cooled
- Heavy water moderated
- Air cooled graphite moderated
- Sodium cooled graphite moderated
- Water cooled graphite moderated
- Organically moderated and cooled
- Liquid fueled systems
 - Molten Salt
 - Aqueous Homogeneous
- Space Reactors
 - Nuclear Rockets
 - Space Reactors





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Early Reviews Were Done Without the Availability of the Regulatory Guidance and Structure Established for Current LWRs

- **Early reviews were customized and based on engineering experience and judgement of participating individuals**
- **As LWR reviews became more numerous ~ 1960, they also became more objective and regulatory guidance was developed, which provided structure for both the applicant and the regulator.**
- **For non-LWRs explicit use was made of the LWR guidance where applicable, the practice continues today**
- **Reactors Built under the Cooperative Power Reactor Demonstration Program were licensed under the part 104 licensing process (research and testing reactors)**
 - **Congressionally mandated joint cost/risk sharing program between the AEC and private industry to promote commercialization of nuclear power**



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Construction Permits and Operating Licenses were Granted for Two Commercial Gas-cooled Power Reactors

■ Peach Bottom 1

- 40 MWe Philadelphia Electric Co. (Cooperative Power Reactor Demonstration)
- Construction Permit (CP) 1962, Operating License (OL) 1967, shutdown 1974
- AEC review (104 license)

■ Fort St Vrain

- 350 MWe Public Service Company of Colorado
- CP 1968, OL 1973, shutdown 1989
- AEC review





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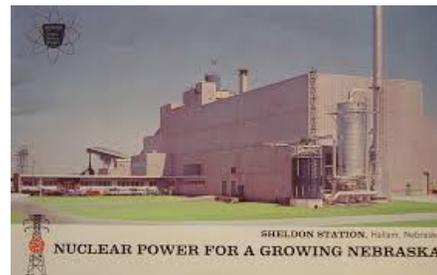
Construction Permits and Operating Licenses were Granted for Two Sodium-Cooled Reactors

■ Hallam Nuclear Generating Station (Sodium Graphite Reactor)

- 75 MWe Consumers Public Power District (Cooperative Power Reactor Demonstration)
- CP 1959, OL 1963, shutdown 1964
- AEC review (104 license)

■ Fermi 1 Nuclear Power Plant (Metal Fueled Fast Breeder Reactor)

- 69 MWe Power Reactor Development Co. (Cooperative Power Reactor Demonstration)
- CP 1956, OL 1963, shutdown 1972
- AEC review (104 license)





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Construction Permit and Operating License was Granted for a One of a Kind Reactor

■ Piqua Nuclear Power Facility (Organically-cooled and moderated Reactor)

- 12.5 MWe Piqua Municipal Utilities, Piqua, OH (Cooperative Power Reactor Demonstration)
- CP 1957, OL 1963, shutdown 1966
- AEC review (104 license)





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Fast Flux Test Facility (FFTF): Example of a DOE Regulated Facility that used NRC to Perform the Technical Review

- **FFTF was a sodium-cooled Fast Flux Test Reactor built on the DOE Hanford Site**
 - **AEC, ERDA, and later DOE regulated facility**
 - Used NRC and ACRS to re-evaluate the design prior to operation
 - PSAR submitted to AEC in September 1970
 - NRC formed in 1974
 - **ERDA/DOE requested NRC /ACRS review of the PSAR**
 - Did not require an NRC license to operate
 - But did request an NRC technical review
 - To be sure this facility would meet the strictest, independent regulations
 - To bring the NRC up to speed on licensing sodium-cooled fast reactors
- NOTE: DOE expected fast reactors to be built soon in rather large numbers, so they desired an in-depth FFTF regulatory review to “jump start” the licensing review process for LMFBRs*
- NRC Safety Evaluation Report issued Aug. 1978 (supplement 1979)

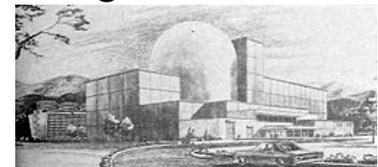


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Clinch River Breeder Reactor (CRBR) was a Demonstration Reactor Licensed by NRC (Commercial) using 10CFR50

- **CRBR was a joint demonstration project between DOE and private industry (TVA and Commonwealth Edison)**
- **380 MWe sodium-cooled fast breeder reactor was to be built at a TVA site near Oak Ridge, TN**
- **Intended to be licensed as a commercial reactor under NRC**
- **Followed the existing LWR process**
- **Required exemptions/exceptions, and modifications to the existing LWR regulatory criteria (e.g., General Design Criteria were revised to reflect unique LMFBR aspects of the design)**
- **Two phases of licensing**
 - Licensing began 1974, NRC work stopped by President Carter in 1977
 - September 1981 licensing renewed, stopped in 1983 by Congress
 - Received a Limited Work Authorization in 1983
 - ASLB positive finding but no CP





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Conclusion

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- For 20 years the AEC licensed a wide variety of non- LWRs mostly using customized reviews based on engineering experience and judgement
- Starting in the 1960s when LWRs began to be the reactor of choice the reviews became more objective evolving into what is the current set of LWR-focused regulations
- Non-LWRs since the 1960s timeframe have been licensed using the same process as the LWRs but using exceptions and exemptions where LWR requirements are not adequate or do not apply