1. Recent Activities of the International Group on Research Reactors (IGORR) and of the Advanced Neutron Source (ANS)

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ABSTRACT

The International Group on Research Reactors (IGORR) was formed in 1990 to facilitate the sharing of knowledge and experience among those institutions and individuals who are actively working to design, build, and promote new research reactors cr to make significant upgrades to existing facilities.

The Advanced Neutron Source Project expects to complete conceptual design in mid-1992. In the present design concept, the neutron source is a heavy-water-cooled, moderated, and reflected reactor of about 350 MW(f) power.

INTERNATIONAL GROUP ON RESEARCH REACTORS

About 10 research and test reactors have been commissioned in the last decade or so, and almost as many major upgrades of existing facilities are underway or have been completed. In addition, at least four major new research reactors are in the construction or design phase (Table 1). During this period new technologies (e.g., silicide fuels), new regulations, and new scientific opportunities have emerged and have influenced reactor and facility design.

During this period, there was no organized forum devoted entirely to the exchange of information and the sharing of lessons-learned among the various groups involved in research reactor design, construction, and upgrade projects around the world. Informal discussions resulted in widespread agreement that such a forum would serve a useful purpose, and, accordingly, a proposal to form one was submitted to several leading organizations known to be involved in research reactor projects. Essentially all agreed to join in the formation of an International Group on Research Reactors and nominated a senior staff member to serve on its international organizing committee.

The committee organized the first meeting of IGORR, which was hosted by the Advanced Neutron Source (ANS) Project of Oak Ridge National Laboratory. The meeting dates and a specific agenda were prepared in consultation with the wider research reactor community. The first IGORR meeting took place on February 28-March 2, 1990, in Knoxville, Tennessee, USA. It was very successful and well attended; more than 50 scientists and engineers from 25 organizations in 10 countries participated in 2 1/2 days of open and very informative presentations and discussions. There were two workshop sessions, one on the R&D needs of IGORR members and one on worldwide facilities, plans for various user needs, offering opportunities for more detailed interactions. Speakers were asked to provide manuscripts, and proceedings of the meeting were prepared (ref. 1).

Table 2 taken from the *Proceedings* summarizes the findings of the session on R&D needs. The final column and footnote to the table have been added recently and indicate that results are now available for sharing with the community in certain of the key research areas (refs. 2-6).

It was also agreed that a newsletter would be an appropriate way of keeping IGORR members notified of major changes or additions to the various projects in progress or being planned, and two newsletters have already been issued (Ref. 7). The newsletter is compiled from material solicited from the IGORR organizing committee and from other members.

Dr. Bernard Farnoux offered to host a second IGORR meeting, which will be held at Saclay, France, on May 18-19, 1992. The dates were chosen so that members could attend IGORR-2 and also the International Conference on Irradiation Technology on May 20-22, 1992, in Saclay that is being jointly organized by the Commissariat a l'Energie Atomique/CEN, Saclay, France and the Commission of the European Communities/JRC Institute for Advanced Materials, Petten, The Netherlands.

The ANS Project has certainly benefitted from the communications established through IGORR, and we believe that other members find the organization valuable also.

ADVANCED NEUTRON SOURCE PROJECT

The Advanced Neutron Source (ANS), a proposed new reactor-based facility for all kinds of neutron research, is currently in the conceptual design phase. Table 3 lists the top-level technical objectives of the project, and Fig. 1 is the schedule presently proposed by the Oak Ridge National Laboratory (ORNL).

The conceptual design and the associated R&D activities are a team effort, involving national laboratories, universities, and industry; funded by the U.S. Department of Energy (DOE); and led by Oak Ridge National Laboratory. Table 4 lists the major past and present participants.

Given that the main scientific justification for the project is neutron beam research, the broad outlines of the reactor system design are easily understood: we need a small, high-power core surrounded by a large reflector so that a high-thermal neutron flux is generated outside the core where it is accessible to neutron beam tubes and to cold and hot neutron sources. Figure 2 is a computer drawing of the core and reflector tank components.

The project has devised a core design (Fig. 3) that combines the short heated length (and hence the high-power density capability) of the High Flux Isotope Reactor and the long neutronic length (and hence the high-neutronic efficiency) of the High Flux Reactor at the Institut Laue-Langevin. It is heavy-water cooled and reflected, with coolant flowing upward through the core to avoid the need for a flow reversal during the transition from forced to natural convection.

Safety considerations have played a major role in the ANS conceptual design. Probabilistic risk analyses have been used to examine proposed design features and to improve the design. As with the U.S. DOE's Advanced (Power) Reactors Program, passive safety features are employed to decrease risk (Fig. 4).

The reactor serves only as a source of neutrons for the experimenters. The design of the experimental facilities is guided by the user community through the National Steering Committee for an Advanced Neutron Source (NSCANS). Table 5 lists the major research facilities planned at the ANS. Of course, these figures may be modified somewhat as the design proceeds and in response to new scientific opportunities, but major changes are not expected.

CONCLUSION

The international research reactor community has been strengthened by the formation of an International Group on Research Reactors (IGORR). The activities of IGORR include meetings and newsletters to exchange information and to provide a mechanism for identifying common research needs and for sharing results.

The Advanced Neutron Source is planned as a major new neutron research facility in the United States. It will provide neutron beams an order of magnitude more intense than any now available, as well as isotope production and materials irradiation testing capabilities.

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Table 1. Some new research reactor projects

Reactor	Country	Power, MW	Status
PiK	USSR	100	In construction
KURR	S. Korea	30	In construction
FRM-II	Germany	20	Design
ANS	USA	350	Design
TRIGA	Morocco	1.5	In construction
"	USA	1.1	In construction

Table 2. R&D needs identified at IGORR-I

topics: \ being planned (+) or results needed (o):	ANS	FRM-II	MURRI	BNL	Riso	JAERI	Petten	Berlin	ORPHEE	MAPLE	MIT	Status
1. Thermal-hydraulic tests and correlations	+	o	+	o		+						
2. Corrosion tests and analytical models	+	o	o								o	*
3. Multidimensional kinetic analysis for small cores	o	o								+		
4. Fuel plates fabrication	+	+										
5. Fuel plates stability	+	+	o									*
6. Fuel irradiation	+	o	+			+						*
7. Burnable poison irrad.	+	+										
8. Structural materials irradiation	+	o	+	+			+	o	+	+		
9. Neutron guides irradiation	o	o				+						
10. Cold Source materials irradiation	o	o			+			o	+			
11. Cold Source LN_2 test	+											
12. Cold Source LH_2-H_2O reaction (H or D)	o	?		+		+						
13. Instrumentation upgrading and digital control system	+		o	o			+		+			
14. Man-machine interface	o	o									+	

Comments: + results needed and own work/tests planned.
? results needed, but own tests not decided yet.
o results needed, but own work not planned.
* results obtained since the IGORR meeting.

Table 3. Mission of the Advanced Neutron Source

To design and construct the world's highest flux research reactor for neutron scattering

- 5-to-10 times the flux of the best existing facilities

To provide isotope production facilities that are as good as, or better than, the High Flux Isotope Reactor (HFIR)

To provide materials irradiation facilities that are as good as, or better than, the HFIR

Table 4. Major participants in the ANS Project

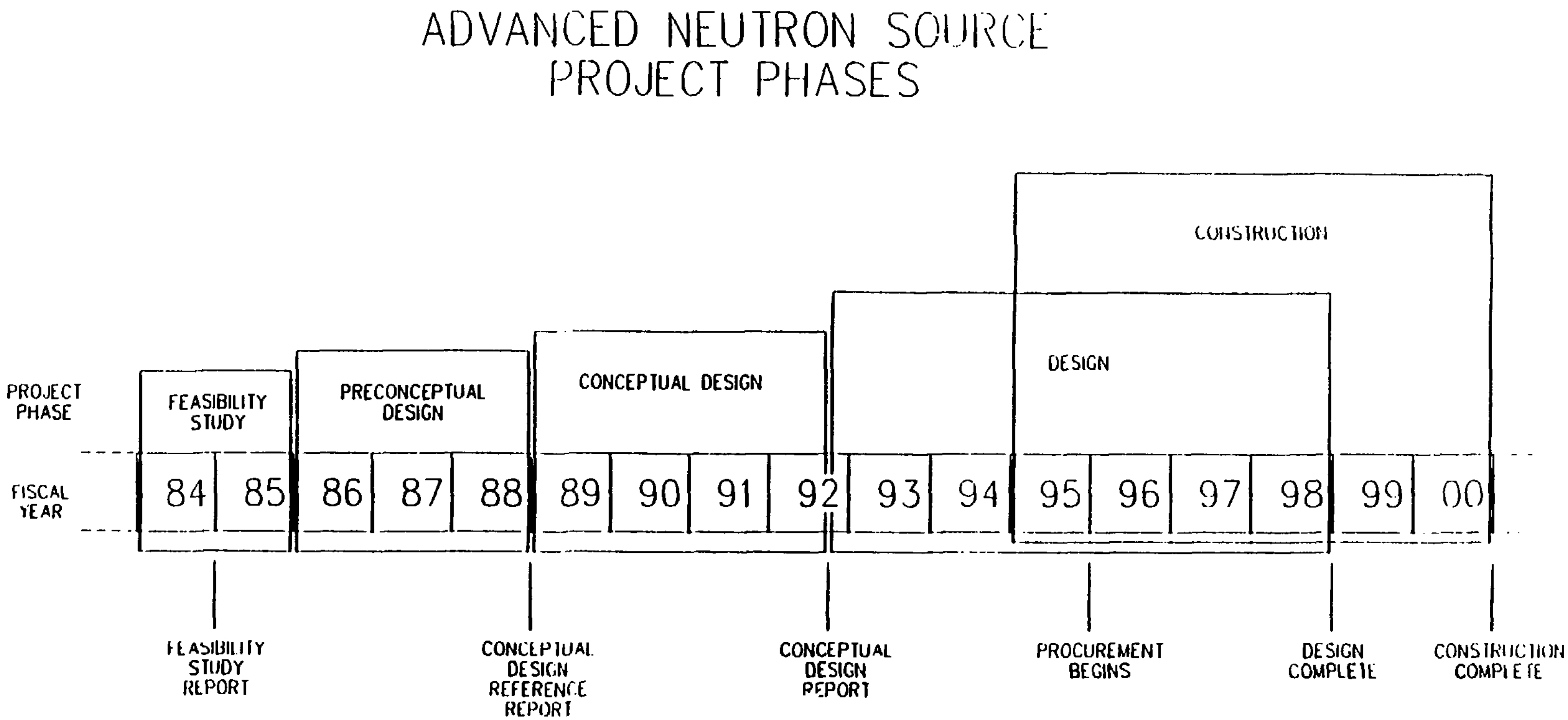
Oak Ridge National Laboratory	Kyoto University
Brookhaven National Laboratory	Tohoku University
Argonne National Laboratory	Kinki University
Idaho National Engineering Laboratory	Osaka University
Babcock & Wilcox	Nagoya University
University of Tennessee	Kyushu University
University of Virginia	Japan Atomic Energy Res. Inst.
University of California	Interatom GmbH
Australian Nuclear Science & Technology Org.	

Table 5. Quantitative expression of performance goals

Neutron beams	
Peak thermal flux in reflector, $m^{-2}.s^{-1}$	$5\text{-}10\times10^{19}$
Thermal/fast flux ratio	≥80
Materials irradiation	
Fast flux, $m^{-2}.s^{-1}$	$\geq1.4\times10^{19}$
Fast/thermal flux ratio	≥0.5
Transuranium production[2]	
252Cf production rate, g/y	1.5
254Es production rate, micro/yr	40

[1]To match or exceed the capabilities of the irradiation positions in the HFIR flux trap.

[2]To match or exceed production capabilities at HFIR.


ADVANCED NEUTRON SOURCE
PROJECT PHASES
PROJECT PHASE
FISCAL YEAR
FEASIBILITY STUDY
PRECONCEPTUAL DESIGN
CONCEPTUAL DESIGN
DESIGN
CONSTRUCTION
84
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FEASIBILITY STUDY REPORT
CONCEPTUAL DESIGN REFERENCE REPORT
CONCEPTUAL DESIGN REPORT
PROCUREMENT BEGINS
DESIGN COMPLETE
CONSTRUCTION COMPLETE

Figure 1

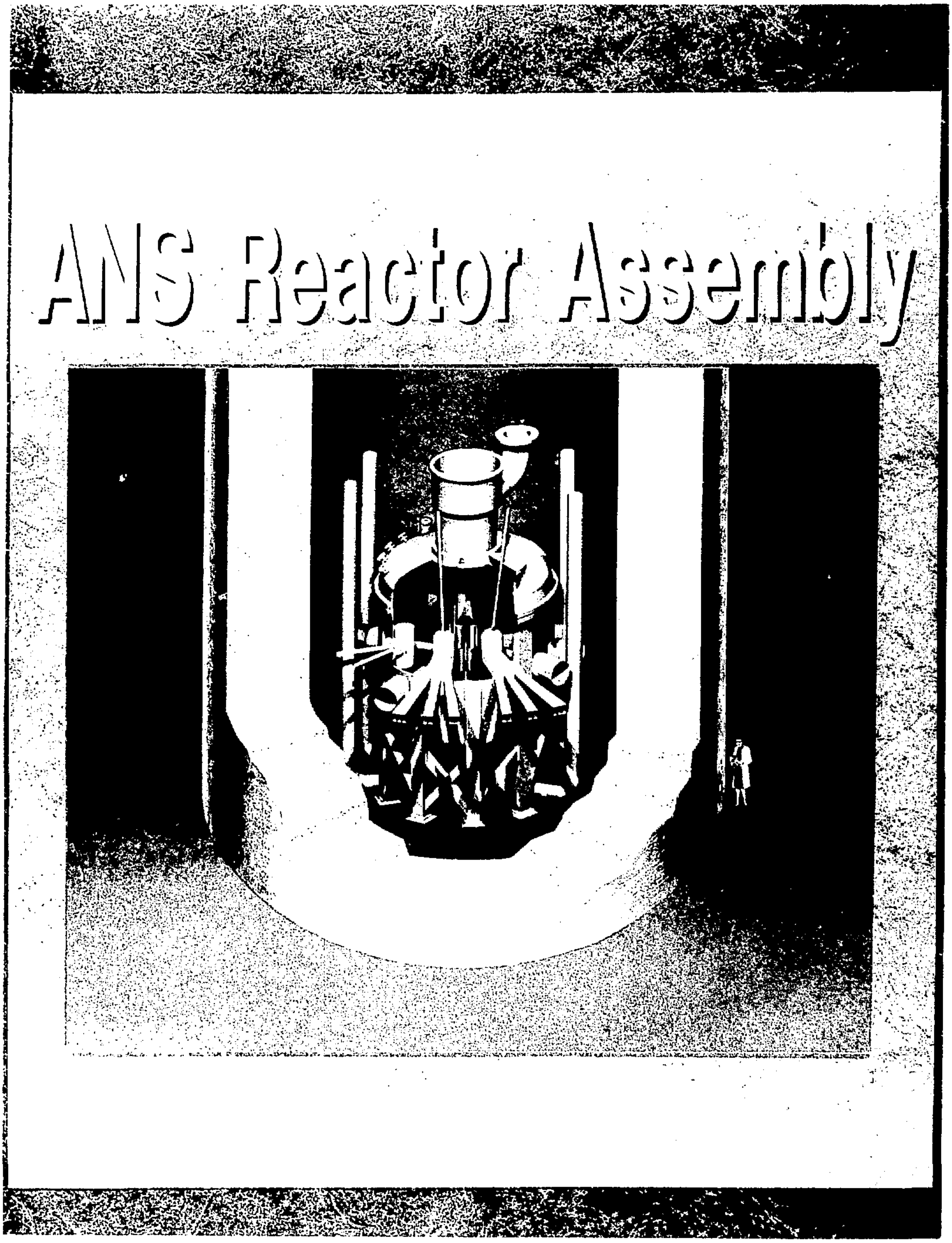

Figure 2. ANS Reflector Tank

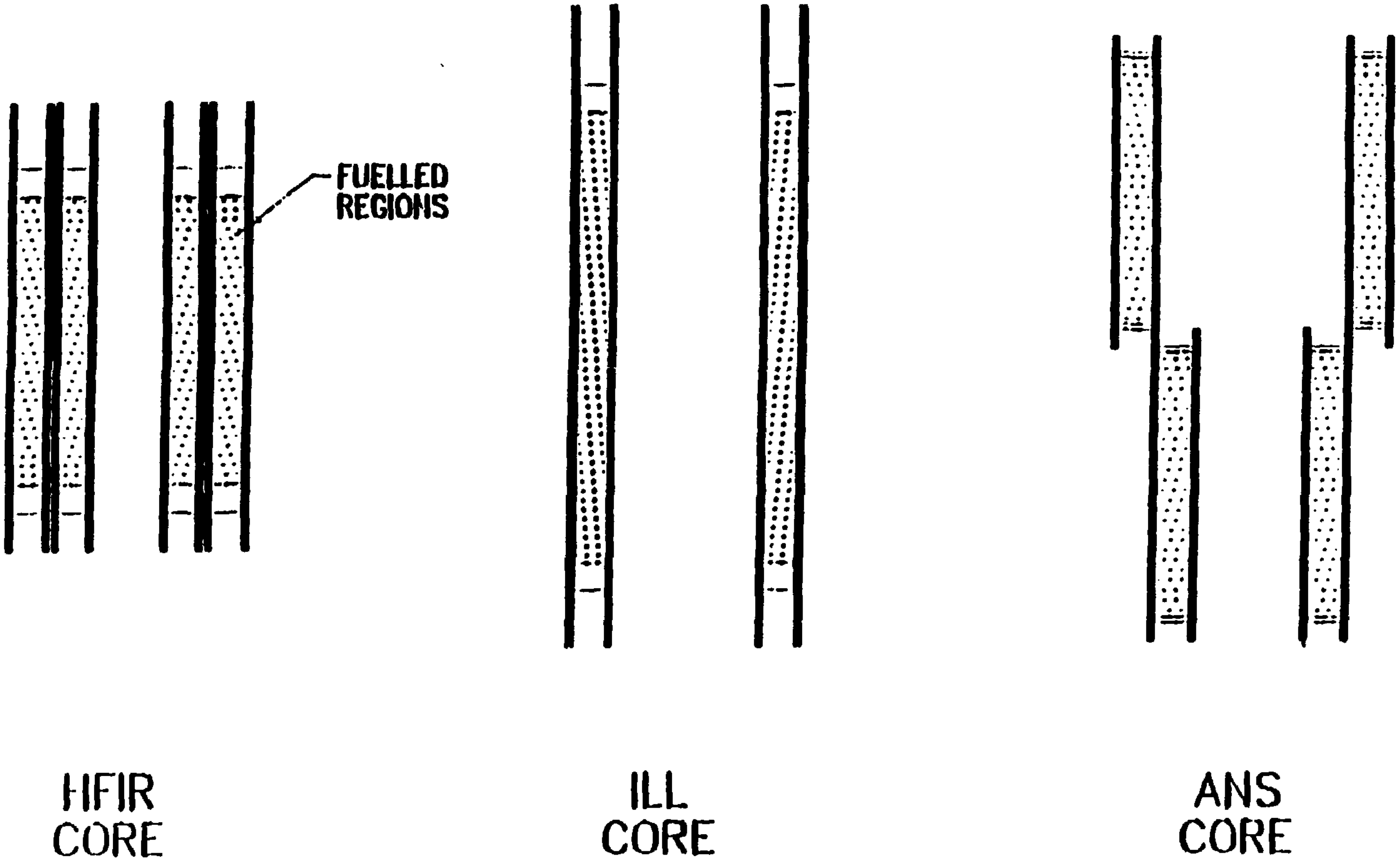

Figure 3. HFIR, ILL, and ANS Cores

SOME PASSIVE SAFETY FEATURES OF THE ADVANCED NEUTRON SOURCE REACTOR COOLING SYSTEM DESIGN

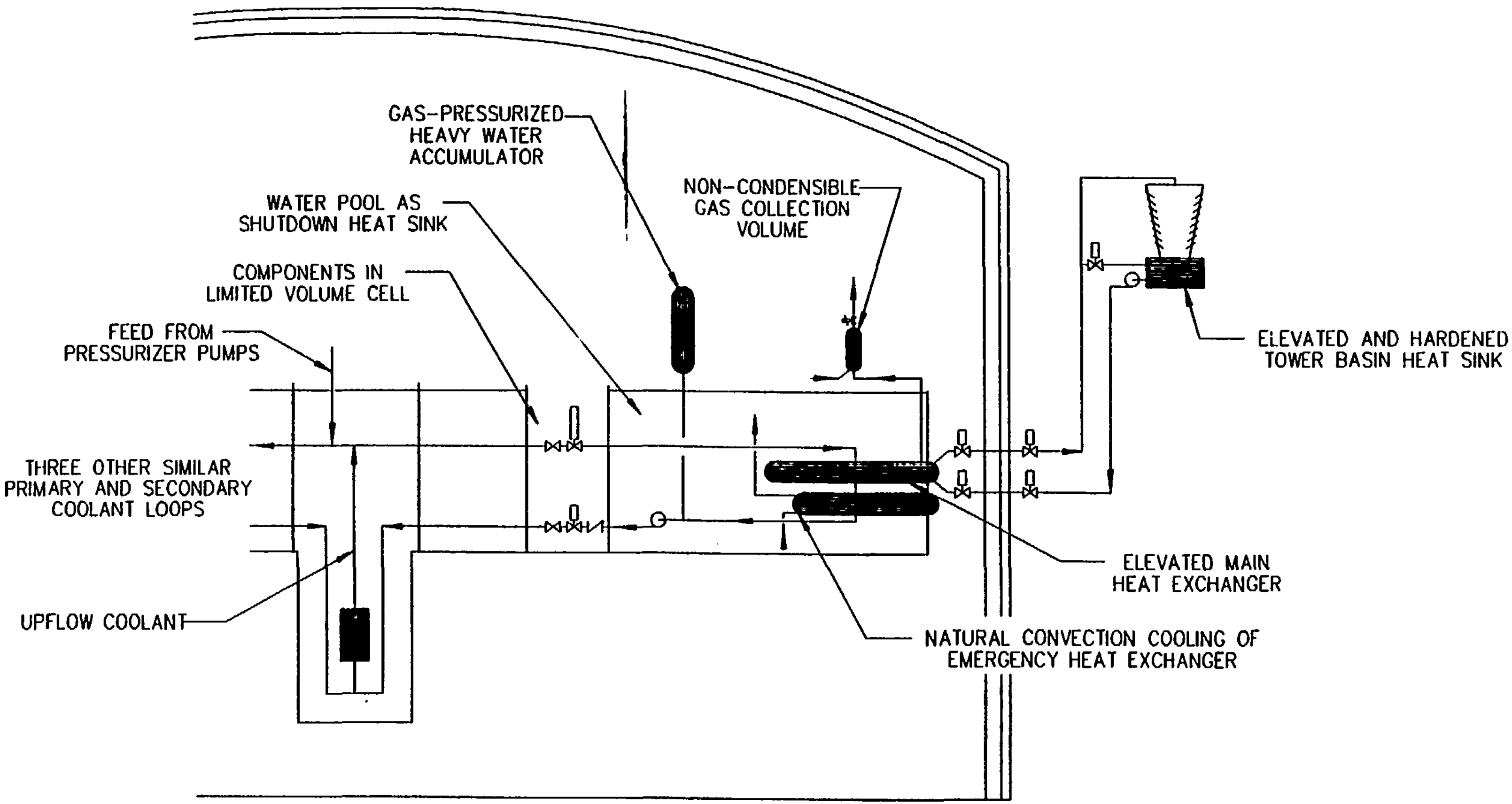

Figure 4.