L.5. Future Development LMFBR-Steamgenerators SNR2 — J. Essebaggers, J. G. Pors — Netherlands

SUMMARY

The developmentwork for steamgenerators for large LMFBR plants by Neratoom will be reviewed consisting of:

1. Development engineering information
2. Concept select studies followed by conceptual designs of selected models.
3. Development manufacturing techniques.
4. Detail design of a prototype unit.
5. Testing of sub-constructions for prototype steamgenerators

In this presentation item 1 and 2 above will be high lighted, identifying the development work for the SNR-2 steamgenerators on short term basis.

FUTURE DEVELOPMENT ACTIVITIES OF NERATOOM ON STEAMGENERATORS

Introduction

Based on the know-how and experience gained from the design, fabrication and testing of the steamgenerators for the SNR-300, Neratoom has initiated a program for the development of the steamgenerators for the SNR-2 with the goal that components will be available by the end of 1980.
In this program the following subjects will be given attention:

1. Development engineering information.
2. Concept selection studies followed by conceptual designs of selected models.
3. Development of manufacturing techniques.
4. Detail design of a prototype unit.
5. Testing of sub-constructions for prototype steamgenerators.

ad 1. Development engineering information

The information to be further developed under this part of the program is among other things

- heat-transport correlations
- flow patterns in the components
- temperature distribution in the different parts of the S.G. at steady state and nonsteady state conditions
- static and dynamic flow instability phenomena
- dynamic response for control analyses
- vibration of tubes
- erosion, corrosion and mass transport

The results of these detailed studies will effect the design of the component as to configuration choice of material etc., but will not affect the concept selection to a large extend.

ad 2. Concept selection studies

Some problem area's need resolution prior to determine the largest possible size of the component at the earliest possible time. These problem area's are among others

a. Study of the accident design pressure as a function of the sodium and water contents of the component
b. Needs and possibilities of H_2 detection
c. Economic optimum
   - number of components given by total power
   - influence of process parameters (steam pressure and temperature)
d. Once through or recirculation
e. Studies for producing large-high quality- tube sheets

ad 3,4 and 5. These activities: design of a prototype, development of fabrication techniques, and fabrication of sub-constructions don't need any further explanation.

In order to be able to start with the concept selection studies without having the results of engineering information as mentioned under item 1 and 2 it is necessary to make some assumptions, such as:

1. accident pressure does not increase with increasing size
2. H_2 detection no problem
3. the number of units per loop will not affect the type of concept to a large degree
4. the steamgenerators will be of the recirculation type
5. production of large tube sheets is possible
6. no decay heat removal through the steamgenerators
7. the medium water/steam on tube side
8. single wall tubes

Based on a) these assumptions (1 through 8)
b) present technology
c) feelings

Neratoom has for the moment chosen for 6 steamgenerators for a secundary loop of 1250 MWt.
This choise means an upscaling of the SNR-300 components with a factor of about 2.5.

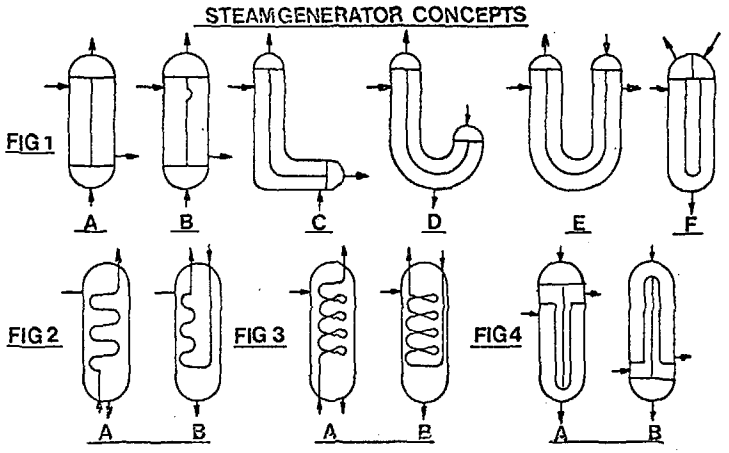
With the assumption that the temperature-ranges will be about the same as in the SNR-300 the most important system parameters will be the following:

		Evaporator	Superheater	Dim.
Component power		137	73	(MWt)
Sodium side				
flow		895	895	(kg/s)
sod.temp.	in	455	520	(^{o}C)
	out	335	455	(^{o}C)
Water side				
flow		100	95	(kg/s)
temp.	in	253	356	(^{o}C)
	out	355	500	(^{o}C)
Steam pressure			167	(bar)

In order to conduct a conceptual design study it is necessary to establish first the basis for comparing each concept with the design objectives and concept criteria.
Not all criteria can be met in one concept, compromises need to be made, however, not at the expense of the most desirable features. So for a proper selection a priority order needs to be given to each requirement from most essential down to those which are preferable but which would not have a major influence on the concept selection.
A possible priority selection:

Criteria related to safety shall be given a high priority relative to:
Criteria on reliability, availability, maintainability and adaption to the system.

This rough selection leads to the following criteria for the concept selection study.



1. Safety criteria
   - Analysable under the current codes
   - Assure that all welds are properly inspectable
   - Have a minimum water inventory and provisions for fast discharge of the water and sodium content in the event of a S.W.R.
   - No impact on the environment in case of a S.W.R.
   - Sodium piping to be separated from the waterpiping
   - Utilization of proven technology by extrapoloting current designs
2. Criteria on reliability, availability, maintainability, adaption
   - Preferably allow for periodic inspection of tubes, shell and internals
   - Preferably have a removable tube bundle
   - The construction must allow early leak detection and location of the leaking tube
   - Allow for tube plugging
   - Allow for thermal expansion between
     a) bundle and shell
     b) individual tubes
   - No covergas
   - Allow for draining and venting.

In the concept selection study the concepts given in figures 1,2,3 and 4 will be compared on the hand of these criteria.