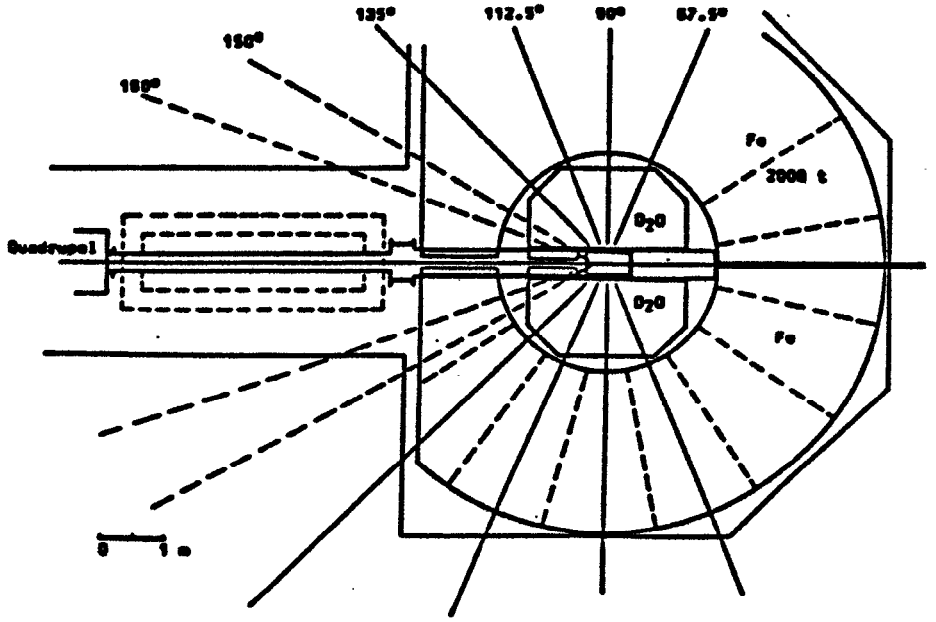

Fig. I-I.6. Schematic layout of the spallation neutron source.

J. An Intense Spallation Neutron Source for West Germany,
J. E. Vetter, KFK Karlsruhe

1. Background

The first generation of research reactors, the neutron sources of today in West Germany, will soon reach an age where significant modifications will be needed to maintain safe and reliable operation. Because of this situation and an increasing demand for irradiation capacity, a modern powerful neutron source in West Germany has been discussed. In 1977 the "MFR Ad Hoc Committee" was appointed by the Minister of Science and Technology to discuss a neutron-source project, which at that time was conceived to be a medium-flux reactor (MFR). The MFR conceptual design, as proposed, is still a viable option and is regarded as an alternative to a spallation neutron source, which was recently recommended by the panel as the most promising concept.

This recommendation was preceded by a discussion with a subgroup which studied various machine concepts under the following assumptions:

- The source should deliver a time-average thermal neutron flux of 6×10^{14} n/cm^2·s, called 'basic machine' in the remainder of this discussion.
- The new source should present the option to increase the neutron flux to a substantially higher value.

It was concluded by the panel that these specifications can be met, but that the needs of the experiments and the capabilities of the machines should be better defined in a two-year study (100 man-years of effort) which would preceed a final decision on construction of such a facility.

2. Concept of the Basic Machine

It is assumed from current experience that a thermal neutron flux of 6 x 10^{14} $n/cm^2 \cdot s$ can be produced by a 600-MeV, 10-mA proton beam. Taking this as the reference for the basic machine, the following target and accelerator configurations were discussed:

- a liquid Pb-Bi streaming target with various geometries
- a rotating water-cooled solid target
- a two-stage sector focusing ring cyclotron (RC) proposed by SIN, Villigen
- a pulsed linear accelerator (LA) designed by KFK, Karlsruhe.

The main parameters of the two machine designs are compared in Table I. Comparison of the accelerator schemes results in only little differences in:

- capital cost
- operation cost
- power consumption
- R & D and construction work.

Some essential differences can, however, be stated in:

- time structure of the beam
- capability of upgrading and flexibility for additional applications.

Cyclotrons are cw operating machines. When being pulsed, the average current decreases. The linac needs to be pulsed in any case for reasons of power economy. The duty cycle of 10% results in a peak current of 10 times the average current which offers the possibility to increase the peak neutron flux in a suitable target/moderator arrangement. In addition, the fast-neutron background can be suppressed by TOF differences.

3. Upgrading Options

Several options to upgrade the 'basic machine' have been discussed. These options are reviewed in Table II.

It should be pointed out that the option to increase the neutron flux is important as it justifies the higher cost and complexity of an accelerator-based source as compared to a reactor system. The comparisons shown in Table II demonstrate that the linear accelerator offers possibilities of either increasing the average flux or, by an additional storage ring, the peak flux. Basic machine and upgrading options will be studied in more detail in the next two years by the KFA and KFK laboratories within the ICANS.

TABLE I

ACCELERATOR CONCEPTS

	RC	LA
Injection energy (MeV)	8	0.5
Intermediate energy (MeV)	85	100
Final energy (MeV)	600	600
Frequency of operation (MHz)	60	100/300
Average beam current (mA)	10	10
Peak beam current (mA)	10	100
Duty cycle	CW	10%
Machine length (m)	-	500
Machine extr. radii (m)	3.2/5 7	-
Av. beam power (MW)	6	6
Av. rf cavity power (MW)	4.5	4.2
Mains ac power (MW)	21	21
Construction cap. cost (M$)	95	100
Annual operating cost (M$)	13	15

TABLE II

UPGRADING OPTIONS

Option	RC	LA
Higher average beam current	Not feasible, problems with beam instability and extraction	Increase of factor of 3 feasible with no modification to system but increase of power consumption from 21 to 56 MW
Higher peak beam current	Not possible	Depends on confidence in beam losses and development of peak power amplifiers
Higher beam energy	Feasible by additional cyclotron stage by ~factor of 3 but hi-current extraction questionable; Capital cost high	Feasible by continuous increase of accelerator length; Capital cost high
Storage ring added to accelerator	Feasible but limited current capability	Feasible, time structure can be matched; H^+/H^- acceleration possible; ultimate current limit to be evaluated

K. Mode of Operation and Target Layout for ILSE, G. S. Bauer, KFA Jülich

An Intense Linac-driven Spallation-neutron source for Experimental purposes (ILSE) is being considered as an alternative to a new medium-flux reactor for beamhole research in West Germany. According to the preliminary concept for the linac to drive the source, a proton energy of 600 MeV, mean current of 10 mA with pulsed operation of 10% duty cycle at 150 Hz is foreseen.[1] Initially it was intended to operate the source with a large D_2O moderator tank in a continuous fashion very much like a steady-state reactor. It is, however, recognized that the pulsed operation of the linac can be taken advantage of to improve the experimental conditions if it is