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THE SUGGESTED MOVE OF ISOLDE TO THE PS BOOSTER

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1. Why move ISOLDE?

The ISOLDE community , which now amounts to well over 200 physicists, has worked at the SC machine for 22 years, and the activity of the group is on the increase. The recent ISOLDE 3 separator has added a powerful new tool, but the SC machine itself has reached the respectable age of almost 32 years and many of the individual components will soon require renovation if the facility is to continue to run reliably for another 10 years. Details of what is involved in this renovation have been presented in reference 1.

A similar problem of ageing is also apparent with the staff of the SC. There are at present 37 full-time staff from PS Division working at the SC, plus 3 people on "prestation". There are 11 operators at present, but by the mid-1990's, it is likely that only 2 will be left because of the additional pension rights which accrue with many years of shiftwork. Furthermore, by the year 2000, two-thirds of the SC's staff will have reached the age of 65. Thus, however the SC may be organised in the future, it will require a considerable injection of new staff if it is to continue to run for many more years, and this seems unrealistic in the present CERN climate.

This somewhat dismal situation for the future of ISOLDE could be transformed by a move to the PS Booster. This is because in the last few years the PSB has become an attractive alternative to the SC in terms of the energy and intensity of its beams. Furthermore, it can produce more pulses than are required for the rest of the present and forseeable physics programme of CERN, and the idea is to make use of this untapped potential.

2. Potential savings.

A move to the PSB means that the SC can be shut down permanently, thus saving the annual running budget of 1.1 MSFr and eliminating the need to spend money on a renovation programme which would otherwise cost in the region of 3 to 5 MSFr. spread over several years. There would be little saving on electricity consumption, even though the SC magnet requires 1 MWatt, since more power would be needed by the PSB. It should also be noted that the cost of building a new facility on a site near the PSB must be offset against the savings (see later).

However there is a big saving to be made in the form of staff posts. Even though a few more people would be needed at the PSB to take care of the additional load which ISOLDE would represent, and the ISOLDE group itself would like to be strengthened so as to allow the facility to run more efficiently than it can at present, basically the whole of the SC staff would be saved in the long term.

3. Advantages for ISOLDE.

The PSB proton beam has an energy of 1 Gev compared to the SC's 600 Mev and this represents an advantage in production cross-section in many of the reactions used to form the highly radioactive species needed in ISOLDE experiments. In terms of intensity, the PSB beam is very similar to the SC beam, with average intensities between 2 and 3 microamps available at the target, using only the otherwise unused PSB pulses. The time structure of the beam is different at the PSB, but most experiments are insensitive to this structure; however there are a few cases where a pulsed beam is a distinct advantage. There are a few technical problems however (see below).

For beams other than protons, there are both advantages and disadvantages at the PSB. The intensity of 3Helium ions which can be delivered from the PSB is lower than at the SC by a factor of 5 or so, but on the other hand the PSB has other ions on offer such as alpha's, and heavier ions which could well be of interest to ISOLDE. A site at the PSB would also make it possible to obtain a beam of high intensity, 50 MeV protons directly from the linac.

Another advantage of a move to the PSB is that it operates with the rhythm of the other CERN accelerators, and so it operates for over 6000 hours each year; the SC only runs for 4000 hours. This means that more physics time is in principle available, or at least there could be a better scheduling of shutdown time and target testing time. Finally, in the list of technical advantages it should be mentioned that the absence of a residual magnetic field from the cyclotron will be most welcome to operating the 60 keV ISOLDE ion beams.

In view of the situation at the SC noted above, such a move to the PSB would give ISOLDE a much more assured future at CERN, and would mean also that for the first time the group would be fully integrated into the rest of the CERN physics programme, rather than working on a completely separate machine, the SC.

4. Problems and consequences.

The main problem which will have to be solved is the stability of the 60keV high voltage applied to the ISOLDE target/ion source. The beam passes through air near the target and there is a high instantaneous current drain due to ionisation of this air with the much higher instantaeous beam current at the PSB than at the SC. The high voltage must be stable to 1 part in 10^5 and there will certainly be a sag, if not a breakdown at each beam pulse from the PSB. A solution has been worked out by the RF group in the PS, and consists of pulsing the HV down to zero just before each beam pulse, with a recovery time of perhaps 20msec. [2] At the same time, there has to be a vertical deflection of the ISOLDE ion beam so that the experiments do not see the beam sweeping across the very narrow defining slits whilst the HV is changing.
There is a further possible problem associated with the PSB time structure which is damage to the ISOLDE target by thermal and mechanical shocks induced by the high instantaneous beam heating during the PSB pulse. This is analagous to the problem at the antiproton production target, but may be expected to be much less severe because the ISOLDE targets are 15mm in diameter, are normally not solid and are at a high temperature of order 2000 degrees, whereas the antiproton production target is a cooled solid rod of 3mm diameter.

From the point of view of continuity there is a strong desire by ISOLDE for the move to be made with the minimum of delay to the physics programme and it is essential for there to be laboratory and target preparation space made available in the immediate vicinity of the new facility; of course similar space near the SC would then be liberated. The ISOLDE group is in the process of preparing a proposal for the post-acceleration of the 60keV beams from ISOLDE, and a solution has been found which could be realised at the SC. This could become an important part of the ISOLDE programme in the future, so any new layout at the PSB should not block this possibility.

One interesting possibility exists at the PSB which would be of interest to ISOLDE , which is the possibility to increase the beam intensity by almost a factor 2 by pulsing at 0.8 second intervals on the ISOLDE cycles, rather than always pulsing at 1.2 seconds. This would require changes in the timing system and some software modifications, but should not be impossible to realise. At the SC a factor 2 increase could also be achieved by running the rotco flat out in the "1 in 1" mode. This however increases the risk of damaging the rf system. Such an increase in intensity, or even using the 1.2 second unused PSB pulses, brings with it a potentially higher activation of the PSB ring. To avoid higher radiation doses to the personnel during routine maintenance it will in future require somewhat better control of the beam losses during acceleration and extraction.

5. Proposed Layout.

A range of possible layouts have been considered, taking account of the available space, and of the need to have the ISOLDE target region well shielded. Initially this gave rise to a proposal to have a minimum sized pit, close to the present Booster beam dump, with the ions then led off vertically to a surface area. However, the total space available close to the Booster is at best marginal and the underground target zone could not be kept small due to the need to change targets frequently and with a minimum of radiation dose. Consequently, it was soon realised that transporting the primary beam through a minimal tunnel to the site shown in Figures 1 &2 would be both less expensive and leave much more freedom to implement a variety of facilities. In addition it offers the possibility of a phased construction of two almost independant separators, and/or a straight ahead beam. Hence although the main motivation for this proposal remains the provision of a long-term ISOLDE facility, it also opens up an area where an intense 50MeV beam could be used (e.g. for isotope production) or where beams of various ions could be used, possibly for Medical Research.

6.Planning & Costs.

The layout described above allows the possibility of moving and commissioning one ISOLDE facility, while the other continues to support a reduced physics programme at the SC. This permits continuity of the physics, and spreads the transfer over two separate periods. Based on this scenario, Figure 3 shows the planning which would allow for the SC closure at the end of 1990, with no break in the physics programme.

The preliminary costing of the civil engineering for this facility, has been made by ST Division and corresponds to 3.3 MSF, of which 650 KSF is the cost of the transport tunnel. To date the first indications are that the cost of technical components, infrastructure & installation could amount to a further 3 MSF. Also, it is now believed that a solution exists to the principal problem of target potential stability. Because of the necessity to excavate next to the Booster enclosure this part of the work would have to be performed during the annual shutdown. Hence, to avoid a slippage of a whole year, (and the corresponding additional SC exploitation cost) it is proposed that the design of the transport tunnel, and a call for tenders, be completed as soon as possible. Meanwhile, it is intended to examine a range of solutions both for the surface building, and the separator(s) with a view to making optimum use of existing beam components, power supplies and shielding blocks. In this way it is expected that significant savings could be made in the required capital expenditure.

7.References.

1. B.W.Allardyce. Renovation of the SC. PS/SC/Note 89-2
2. D Fiander. (Private Communication) (Note in Preparation)

8. Acknowledgements.

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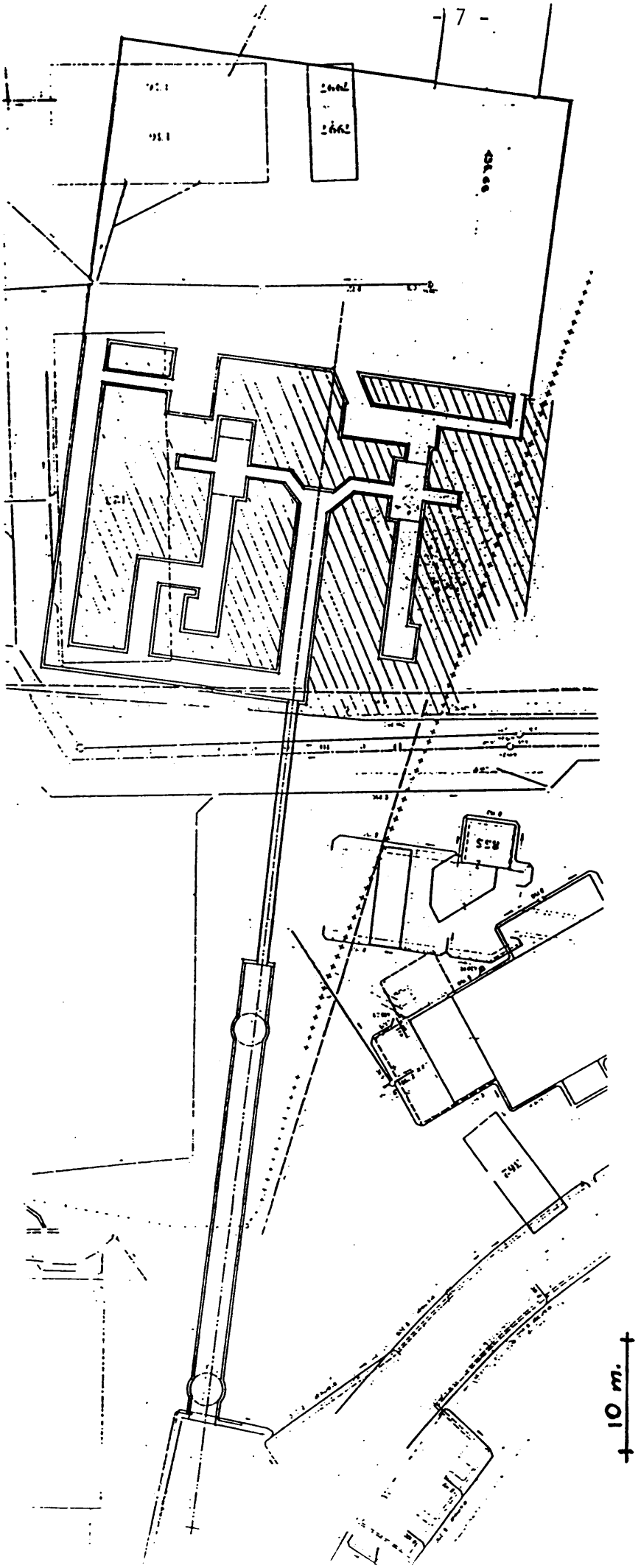


Figure 1 Proposed layout (Plan View)

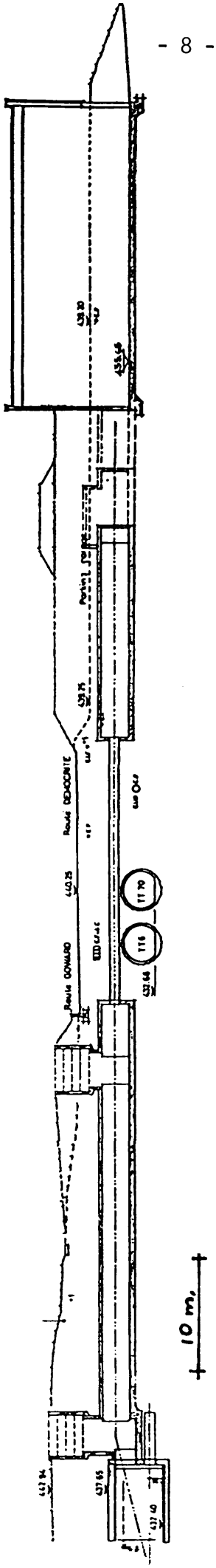
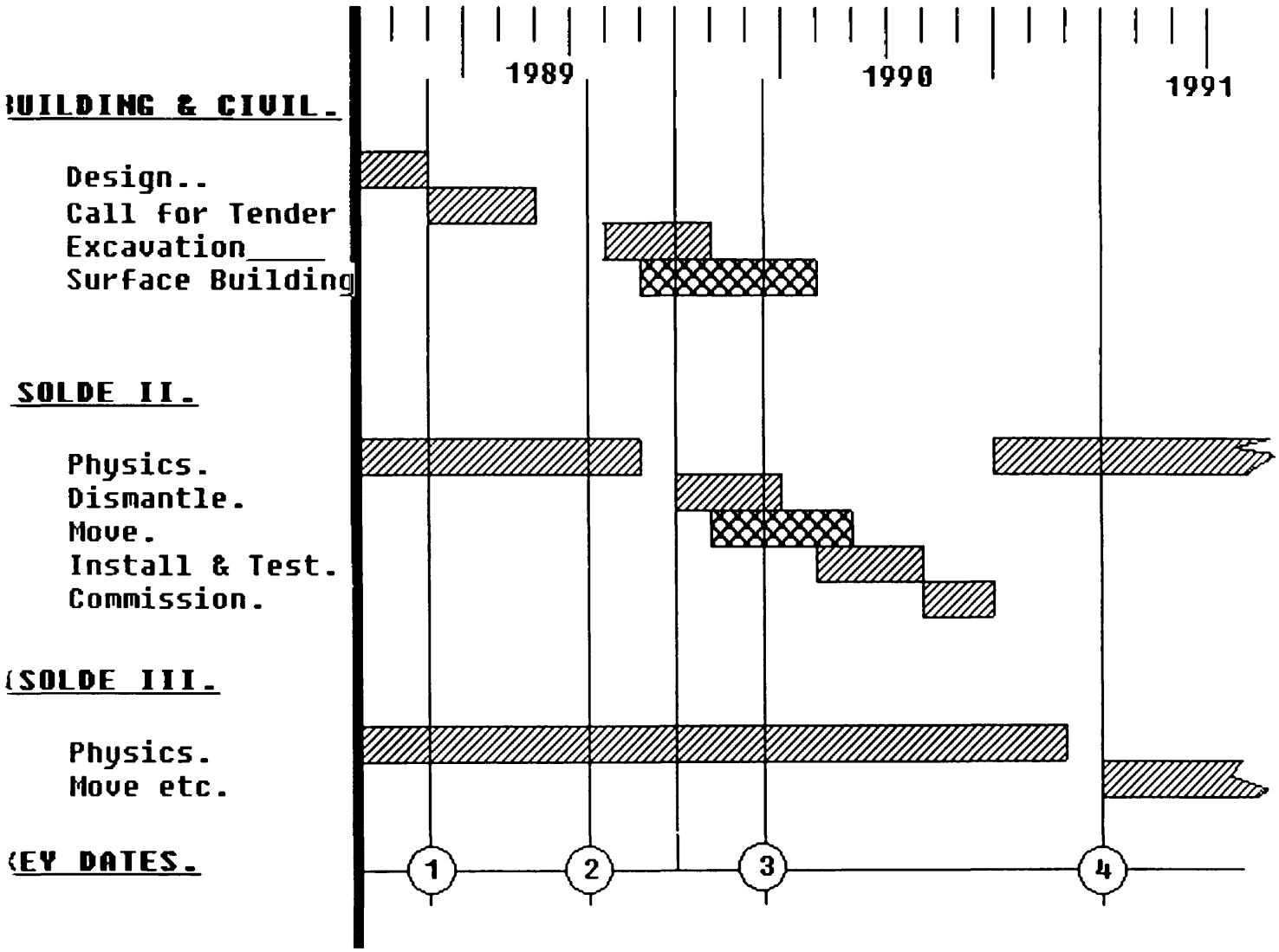


Figure 2 Proposed Layout (Elevation)



1	1st June 89	Call for Tenders.
2	11th Oct 89	Finance Committee.
3	15th Mar 90	PS Start-Up.
4	21st Dec 90	SC Closure.

Figure 3. Time Scale.