COMMENTS on CERN/644 with special reference to Annex CERN/485/Rev.

by Dr. Vernon Wilson and Mr. D.A. Gray

General Comments and Requests for further information

1. The first nine pages set out the basic requirements for a suitable site together with questionnaires on many other factors. If all these questions have been adequately considered by every country invited to suggest suitable sites then CERN must have acquired a very large volume of information. If this is so, then the rest of this report is an inadequate digest.

2. The maps are poor and are physiographically and geologically uninformative, apart from showing the general limits and areas of the sites and the proposed positions of the ring and experimental beam paths in each case. Detailed maps showing the solid geology, superficial deposits and geological structures (e.g. faulting) are requested for all sites.

3. In most sites the profiles supplied are not clearly related to the maps consequently they give an inadequate picture of the physiography of the site. Maps showing contoured topography with rivers, etc. and related profiles should be provided.

4. In many cases the borehole logs do not show any superficial deposits which may be present nor do many of them show the levels of any water which may have been encountered in the boreholes. Can this information be provided please.

5. Very large quantities of water are required in the operation of the proposed machine. Comparative costs of cooling systems (as defined in the design study) are requested for all sites.

6. If stability measurements, comparable in accuracy with those made on the British site, have been made at all other sites none of this information is included. Can this stability information be made available so that all sites can be compared.

The geological statements leave much to be desired and structural aspects of the sites are inadequately considered; yet some of the information given is irrelevant.

Site comments

A. Austrian site (Confrits)

(i) Topographically very irregular and rather small site.
(ii) Difference between highest and lowest points of the ring appears excessive.
(iii) Are there any rivers with associated alluvial areas crossing the site?
(iv) No mention of any structures (e.g. faulting) affecting the site.
(v) No apparent additional area suitable for storage rings for future development. Can the site be enlarged?
(vi) No details given of any water levels in either the Drift deposits or the bedrock. Request this be provided.
(vii) Possible radiation hazard due to "some circulation of underground water" not considered. Where are the natural outlets and is the water from them used for supply?

B. Belgian site (Focant)

(i) Another topographically variable site.
(ii) Difference between highest and lowest parts of the ring appears excessive.

/ (iii)

(iii) No details of any superficial deposits on the Devonian bedrock.
(iv) Structural aspects inadequately considered, but it appears to be very complicated. Request for more structural geological information with an adequate map.
(v) An average of nearly one earth tremor per year in Belgium in last 65 years.
(vi) Destruction of the village of Focant would appear to be involved. Is this so?
(vii) No apparent scope for additional future storage rings.
(viii) Radiation hazard of such limited quantities of ground water as do circulate is not considered. Where are the natural outlets and is water from them used for any supply?

C. German site (Drensteinfurt)

(i) Appears to be a small limited site with no apparent scope for any future expansion.
(ii) There is no note on surface physiography - general contour levels, streams, etc.
(iii) Some faulting appears to be present but is inadequately considered.
(iv) More information is required on the geological structure (faults, etc.); superficial deposits; and water table.
(v) The boreholes record "movable cover" - presumably superficial deposits, but not stated what they are.
(vi) The water table (at 7 metres below ground surface) "does not seem to have been found in drilling". Is it absent or did the method of drilling preclude its observation?

D. German site (Eberaberger Forest)

(i) An extensive, fairly flat site, on glacial deposits, mainly gravels of variable thickness, overlying Tertiary sands and clays. In the north the gravel appears to be only 1.2 metres thick with clays underneath. This is inconsistent with the statement in the last three lines of Introduction 1.2.VI, page 5.
(ii) Difference between highest and lowest points of the ring appears rather excessive.
(iii) Radiation shielding embankments appear to be necessary.
(iv) Water present in the gravels. The water table will vary in both space and time. The regional direction of ground-water movement is indicated by the gradient to the north-west but local seasonal changes in direction may be caused by seasonal infiltration. Seasonal fluctuation of the water level of up to 21.2 metres are recorded in one borehole. This may represent a stability problem with possibly significant differential movements over the area of the ring.
(v) Radiation hazard can probably be suppressed but not entirely eliminated.
(vi) Request information on stability measurements of this site and details of thickness variations of the various deposits with detailed geological map.

E. German site (Neuforweiler)

(i) A difficult site of very varied topography and further complicated by villages and hamlets.
(ii) Excessive difference between highest and lowest points of the ring.
(iii) The ground is structurally complex, i.e. numerous faults.
(iv) A water table problem is present as is the problem of radiation. Capital and running costs of de-watering the site would be much greater than for any other site.
(v) Geological map with structures required. Superficial deposits, if any, should also be shown.

F. French site (Le Luc)

(i) This is a large fairly flat site, though by no means as flat as some of the others.

/ (ii)

(ii) Sizeable towns are at some distance, especially the international airport at Nice.

(iii) The map is vague and indistinct; rivers, streams or other watercourses are not easily apparent from it, and it shows no geology. The profiles are not related to the map but they indicate an uneven site. The boreholes show no superficial material encountered and no water levels.

(iv) No description is given of the physiography of the area. There are rivers and streams crossing the site and, in particular, crossing the ring from west to east.

(v) The geological statement is misleading. It gives the impression that Permian Sandstones make up the entire area. There is no mention of the stretches of alluvium and underlying glacial deposits covering extensive cultivated areas (see published French geological maps) and infilling the river valleys. Wide stretches of these superficial deposits underlie the ring. The thicknesses of these deposits, according to the published French map, are up to 60 ft or more.

(vi) No account is given of any structures affecting the area, e.g. folds, faults, jointing, etc.

(vii) There is no mention of any water table levels either in the Permian Sandstone or in the Drift deposits. Though the site may be partly dry for much of the year there may be water at depth. Water levels could be high in such an area crossed by numerous streams.

(viii) Information is requested on the depths of the superficial deposits and the profiles of the buried river valleys should be determined by geophysical methods.

(ix) The value of the permeability is stated to have been made <u>in situ</u>. Was it determined from pumping tests? Is it indicative of the value for the Permian formation as a whole or was it measured in selected short sections of one or more boreholes, i.e. is it indicative of unfissured formation? Such values can be misleading especially if the borehole sites have been selected away from areas where high permeability is to be expected. Have any measurements been made in these sections of the site crossed by streams in the wide alluvial tracts?

(x) No measurements of water level in the drifts are given. Assuming that there is some seasonal replenishment from rainfall the drift beneath the streams might act as recharge sources for the Permian Sandstones.

(xi) Some of the boreholes appear to have been sited in alluvial areas yet the logs record no superficial material.

(xii) There are intrusive rocks east of the site. Could there be a similar intrusion within the area of the ring but not exposed at the surface? None have been mapped but that does not mean that none are there. Geophysical investigations would disclose these occurrences if they are present.

(xiii) What is the depth of weathering of these Permian Sandstones? Has a study of this weathering been carried out around the area of the proposed ring? If so what are the results? What are the local conditions of fissuring in the sandstones?

(xiv) If the Nardo and Greek sites may be unacceptable on account of excessive summer heat and consequently a difficult water cooling problem, would not a similar factor apply to Le Luc? What are the temperature ranges for the various months of the year at Le Luc?

C. <u>Italian site (Doberdo, S.E. of Trieste)</u>

(i) Rather an awkward shaped site of very varied topography (variation, over 60 ft) and no apparent scope for future storage rings or other expansion. Difference between highest and lowest points of ring appears very high.

(ii) It is a 'karst' limestone area and consequently will be full of fissures and perhaps cavernous at depth; it will probably contain much water. Faults are also present.

(iii) Is there any superficial material in the area which may be masking other faults? Can a good recent geological map be provided.

(iv) A possible radiation effect on the water in the limestone.

/ (v)

(v) The statement that fluctuations in the water table will not affect the stability of the ring may or may not be correct in this case.
(vi) The site boundary is very irregular; the village of Doberdo del Lago is probably too near the ring and would have to be removed.

H. Italian site (Nardo, north of Brindisi)

(i) A fairly flat site, though no boundary is shown on the map.
(ii) Fissures in the thick Cretaceous limestones but no structural complexities present.
(iii) No apparent water table or radiation problems.
(iv) Can information be provided on monthly climatic variations (e.g. temperatures).

This appears to be a very good site.

I. Spanish site (El Escorial, N.W. of Madrid)

(i) A granite horst mass bounded by faults and cut up into blocks by faults. What are the ages of the faults? What are their throws and are they normal or reversed faults, or tear faults? Geological structural map, also showing superficial deposits, is requested.
(ii) The granite appears to be deeply weathered and altered.
(iii) Excessive difference between highest and lowest points of the ring.

J. Swedish site (Uppsala)

(i) Large granite site on which little information is given. More requested.
(ii) Presence or absence of streams is not mentioned.
(iii) Inadequate description of superficial deposits in the area, e.g. the wide infilled fissures may be waterlogged. Detailed geological map should be supplied.
(iv) The granite may be fractured and there may be a radiation hazard comparable with the Austrian site.

K. British site (Mundford, Norfolk)

(i) Some of the geological information quoted is irrelevant and/or inaccurate. Specify
(ii) Much information supplied to CSRN has been omitted.
(iii) The impression that the Chalk is being dissolved away to the detriment of the ring tunnel should be removed as early as possible. Most of the mineral matter in solution is taken up in the top 6 ft of the formation.
(iv) The presence of adequate and relatively cheap cooling water in this area should be emphasized (estimated cost 10 MSF).

Institute of Geological Sciences
(Geological Survey and Museum)
VW/JW

30th August, 1966