GLOBAL COORDINATES OF THE SNS ACCELERATOR COMPLEX*

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Abstract
The global coordinates of the Spallation Neutron Source are determined following the officially approved site wide coordinate system. Lattice output files from computer codes such as PARMILA, TRANSPORT and MAD are used. Integration of various parts of the facility is critical because they are designed by people from different partner labs. Issues related to integration, including interfacing between linac and ring, between beam transport line and the target and between accelerator and the conventional facility are presented.

1 INTRODUCTION
The Spallation Neutron Source (SNS) Project is currently under construction with the participation of six different national labs [1]. The fact that work is being carried out at various locations simultaneously poses new challenge to coordination and information flow. The establishment of the global coordinate system of the accelerator complex deals with every component of the complex and directly involves people from four of the six labs. In order to ensure project-wide consistency, the origin and the axes were agreed upon and defined in the form of an official document [2]. Then interfaces of different parts were clarified and the global coordinates of a few key points were determined. Finally, the coordinates of all dipoles and quadrupoles were calculated. Specifically, the global coordinate system is first outlined, followed by a section describing the interfaces and the critical issues encountered. The last section contains discussions on present status and future plan.

2 SNS GLOBAL COORDINATE SYSTEM
The current SNS global coordinate system was proposed by the SNS Survey & Alignment Group and adopted by the whole project [2]. It is illustrated in Figure 1, which is a two-dimensional drawing of the SNS site. The origin of Y-axis lies in the plane of the accumulator ring. To avoid unnecessary confusion, the coordinates of the origin are defined as (20000, 10000, 2000) in the order of (Z, X, Y).

3 INTERFACES AND INTEGRATION
The issue of interfaces becomes a critical one due to the fact that different parts of the SNS facility was designed by different people at different labs using different design codes. The front end was designed and built by a team at Lawrence Berkeley Lab, the linac by a team at Los Alamos National Lab, the accumulator ring and the beam transfer lines by people at Brookhaven National Lab; and the target station was by people at Oak Ridge National Lab. The linac was designed using PARMILA [3], the beam transfer lines using TRANSPORT [4] and the ring using MAD [5]. An Excel spreadsheet was developed to integrate the various parts into a coherent whole. In order to build the spreadsheet, the geometrical relations among

*Work supported by the U.S. Department of Energy under contract No. DE-AC05-96OR22464.
the parts have to be known. Four points are essential for
the integration, which are the beginning of the High
Energy Beam Transport (HEBT), the end of the HEBT
(beginning of the Injection dump line), the beginning of
the Ring to Target Beam Transport (RTBT) and the end
of the RTBT.

The interface point between the linac and the HEBT is
defined in a straightforward way, which is the center of
the magnet named HEBT.QV1. The end of the
PARMILA output of the linac is the beginning of the
TRANSPORT output of the HEBT. The HEBT ends at
the stripping foil, where the H– ions are converted into
protons. Due to transverse painting [6], the center of the
injected beam at the foil does not lie on the center of the
straight section of the ring (Figure 2). It is 14 cm outside
and 4.6 cm above the ring. Specifically, the relative
position of this point to the midpoint of the injection straight, in the form of the global coordinate system
described above, is (-0.14, -0.605, 0.046). The RTBT
starts at 3.29 m upstream of the Lambertson magnet,
whose upstream end’s relative position to the midpoint of
the extraction straight is (0, -3.4376, -0.1826) (Figure 3).
The end of the RTBT and the distance between it and the
center of the target are also determined. The numbers
above were obtained from sources other than the lattice
files, which were incorporated into the spreadsheet
manually. With the exception of the injection dump line,
the global coordinates of all magnets can be determined.

The uniqueness of the injection dump line lies in the fact
that there are two beams separated horizontally in the
beam pipe. After the foil at the end of the HEBT, most H–
ions are converted into protons. Some are partly stripped
and become H0, which traverse magnet INJBND3 with no
bending. Others are not stripped and remain H–, which are
bent 2.4° after INJBND3 (Figure 2). All H0 and H–
ions are fully stripped by a thick foil in front of INJBND4 and
sent to the injection dump. The reference orbit (center of
the beam pipe) is defined as the path of a particle that is
bend 1.2° by INJBND3 and behaves as a proton
afterwards.

The first result of the work is a list of the coordinates of
16 key points (Table 1), which allows the Survey &
Alignment Group and people in the Conventional
Facilities Division to proceed with their work.

4 STATUS AND PLAN

Currently, a list of the coordinates of all dipoles and
quadrupoles of the ring and the beam transfer lines has
been released. That of the linac is due shortly pending the
release of the final design. Coordinates of other devices
such as sextupoles, correction magnets and BPMs will be
provided in the coming months. The data will be
incorporated in a comprehensive database currently under
development. More work will also be done to increase the
degree of automation in calculating the coordinates.

5 ACKNOWLEDGEMENTS

The authors would like to thank H. Takeda, J. Negrin, D.
Raparia, Y. Papaphilippou, J. Error, D. Stout, C. Peters
and T. McManamy for providing important data and
stimulating discussions.

6 REFERENCES

[1] T. Mason, these proceedings.
(1996).

Figure 2: AutoCAD drawing of the injection area
Table 1: Coordinates of key points along the reference orbit

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Location</th>
<th>Z</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Complex center</td>
<td>Central Monument 00 (MON00)</td>
<td>20,000.000000</td>
<td>10,000.000000</td>
<td>2,000.000000</td>
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<tr>
<td>1</td>
<td>FE end</td>
<td>Last quad in MEBT (QM14)</td>
<td>19,549.720844</td>
<td>10,000.000000</td>
<td>2,000.046000</td>
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<td>2</td>
<td>DTL end</td>
<td>Quad between DTL and CCL</td>
<td>19,586.686974</td>
<td>10,000.000000</td>
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<tr>
<td>3</td>
<td>CCL end</td>
<td>Last quad in CCL-SC Region</td>
<td>19,643.268831</td>
<td>10,000.000000</td>
<td>2,000.046000</td>
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<tr>
<td>4</td>
<td>HEBT beginning</td>
<td>First quad in HEBT (HEBT.QV1)</td>
<td>19,881.174844</td>
<td>10,000.000000</td>
<td>2,000.046000</td>
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<tr>
<td>5</td>
<td>HEBT end</td>
<td>Last quad in HEBT (HEBT.QH34)</td>
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<td>10,102.299981</td>
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<td>First quad after foil (QVA12)</td>
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<td>10,117.136218</td>
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<tr>
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<td>Ring center</td>
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<td>RTBT beginning</td>
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<td>1,999.771400</td>
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<td>12</td>
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<td>Center of target</td>
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<td>9973.648848</td>
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<td>10,022.394270</td>
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Figure 3: AutoCAD drawing of the extraction area