SSC-N-576

SUPERCONDUCTING SUPER COLLIDER
PROJECT

PROCEDURE

FOR

SURVEY DATA MANAGEMENT

Revision 0

December 12, 1988

SSC PROJECT
SURVEY DATA MANAGEMENT

The following describes the method for the transfer, processing and storage of survey data for the SSC Project. Survey data consists mainly of coordinates for points used for describing the configuration of the facility. Two coordinate systems are presently in use for listing these coordinates. The first system has been named the ISP coordinate system because it was adopted for the Invitation for Site Proposals. The design of the lattice of superconducting magnets and other critical points are listed in the ISP coordinate system. The second system consists of the State plane coordinate system extending over the site which has been selected for the project. The State plane coordinate system will be used to locate key components of the facility with respect to local features.

Data from the ISP coordinate system must be used as the basis for the detailed layout of components as well as the description of the land requirements. This makes it necessary to transfer, convert and prepare calculations from data which is shared by the Central Design Group and RTK.

The conversion of survey data and the flow of information will generally conform to the following sequence:

1. Generation of data by the Central Design Group.

2. Transmission of data to RTK.

3. Loading of data into a coordinate geometry database.

4. Computations using coordinate geometry and interactive graphics software.

5. Conversion of data into the State plane coordinate system.

6. Plotting of data into graphics design files.

7. Output of information into data files.

8. Transmission of data to Central Design Group.

In the following sections, a detailed description of the procedures is given for the above items.

1. <u>Generation of Data at Central Design Group</u>.

Data to be transferred to RTK will be stored in ASCII text files in a VAX system at the Central Design Group. The files will consist of columns containing (1) the point number, (2) The Y coordinate, (3) the X coordinate, (4) the Z coordinate (optional), and (5) other optional data. Header data will be included in order to identify the file and provide other information associated with the file such as the units. If units are not specified, international feet will be assumed. The point number will be integer and will contain no alpha characters. Columns will be separated by a minimum of one blank space.

The CDG data files will consist of points along the "beam line" lattice. Each file will define a different configuration. Certain configurations will be used to generate new land area footprints. Other designated lattice configurations will not be used to generate new footprints but will be placed and oriented within existing footprints in order to determine the available clearances.

Before a new version of the detailed footprint is constructed, a skeletal "beam line" lattice is created by the CDG, and is made available for use by RTK. For example, suppose that a footprint corresponding to a new magnetic lattice called LATTICE is required. An ASCII file containing a survey of the coordinates of all the quadrupoles in this lattice is placed in the area LBL113:[SSCDB.FOOTPRINT] on the VAX cluster at the Lawrence Berkeley Laboratory. The date of creation of the file is included in its name. For example, if this file was created on the first of December, 1988, then its name would be LATTICE881201.POINTS.

This file is then available for acquisition by RTK, as input to the process of creating the detailed footprint. The simplest way to get this file into the RTK computers is to log on to the LBL cluster, using a 2400 baud modem calling into one of the cluster phone posts, and then to invoke KERMIT to control a file copy operation. Transfer in this way takes several minutes. This transferal time is acceptable since it is unlikely that the process will be repeated more than a couple of times per week.

2. <u>Transmission of Data to and from RTK</u>.

Data will be transferred to and from RTK by telephone. The configuration of the transfer equipment consists of the following:

File transfer will utilize a 2400 baud Hayes compatible modem. A 9600 baud unit may become available at a later date. The modem will connect to an IBM PC. Kermit protocol will exist on both the VAX cluster at the Central Design Group and the IBM computer at RTK.

The transfer procedure consists of the following:

(1) The IBM computer will work in a DOS mode (at a C> prompt), outside of the standard RTK menu system.

(2) Execute KERMIT and set the parameters:

C> KERMIT

KERMIT> SET PORT 2

KERMIT> SET BAUD 1200 (or 1200 as appropriate)

(3) Connect to port for call:

KERMIT> C
ENTER (BY DIALING) PHONE NO. FOR VAX. (486-4979 for 1200 BAUD)
(486-4969 for 2400 BAUD)

ATDT91234567. (Enter number corresponding to modem speed using upper case characters)

(4) Connection to VAX:

After VAX answers and connects, press <carriage return> and enter:

CSA (or a specific VAX such as CSA4)

This selects a VAX for login and issues a standard login prompt.

Username: NAME (as given by LBL)
Password: (as given by LBL)

The login should place the user in the directory required for file transfer.

(5) Execute VAX KERMIT

$ KERMIT

(6) Place VAX in server mode.

KERMIT - 32> SERVER

Use specified escape sequence to return to PC KERMIT mode such as (control) (minus) followed by (C).

(7) Request the file:

KERMIT> GET filename.ext (to transfer from VAX to PC)

KERMIT> SEND filename.ext (to transfer to VAX from PC)

(8) Release VAX:

```
KERMIT>  FINISH
KERMIT>  BYE
KERMIT>  EXIT
C>
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(9) Transfer from PC to RTK VAX:

(These are standard KE procedures.)

The received files will be copied into a duplicate file which will be edited as required for further processing. This would consist of loading into a survey database for coordinate geometry computations or translation into the State place coordinate system.

3. <u>Loading of Data into the Coordinate Geometry Database</u>.

The system to be used for storage and computations for survey data consists of the Interactive Coordinate Geometry Subsystem (ICS) which is a software package by Intergraph Corporation. To use this system, a database file is created for the storage of point numbers. After the database is created, the ICS program is activated and the table of point numbers is entered using the "INPUT FILE" command. Output files may also be created during the time that ICS is active. These output files may be retained as documentation of the contents of the database or for transmission of data to other systems.

Information which has been entered into the database may be used in computations using (ICS) coordinate geometry software or may be plotted into graphics files and used to prepare drawings or to do additional computations using interactive graphics design software (IGDS). Selected coordinates which are generated using IGDS will be transferred to the ICS database.

4. <u>Computations Using Coordinate Geometry Software</u>.

Points in the ICS system are stored in the database with a specific point identification number, coordinates and associated graphics features which are used in plotting points. Figures are also stored in the database. These consist of associations of points which may define a series of line segments, and circular or spiral curves.

ICS operates in both the interactive mode (using an attached graphics file) or in the batch mode. In the interactive mode, commands used to initiate a computation may be selected from a table or screen menu or may be keyed in. After the selection of a command, the data required for the computation must be keyed in using a prescribed sequence. For example, to store a new point with known coordinates, the command "STORE" is either keyed in or selected from a menu. The required data consists of (1) the point identification, (2) the first horizontal coordinate, (3) the second horizontal coordinate, and (4) the elevation.

This sequence determines the required arrangement of input files because the "STORE" command activates the input of these files and looks for the point data in the prescribed sequence.

5. **Conversion to State Plane Coordinates**.

ASCII files containing lists of points with coordinates in the ISP Coordinate System, may have the coordinates converted into the State plane coordinate system. This conversion will be done by submitting file to the program "PLANE.EXE" designed to calculate the State plane values based on existing programs obtained from the National Oceanic & Atmosperic Association with modifications inserted to suit the requirements of the SSC Project. A complimentary program "ISP.EXE" may be used to convert State plane coordinates to the ISP coordinate system.

These programs are operated on the RTK VAX system in the DCL environment. Input may be obtained from a file such as an ICS output file and may be processed in batch mode. Output may be obtained as an output file with (1) only the point numbers and converted coordinates or (2) with intermediate values generated during the computation.

Both of these programs have been designed by RTK and may be operated in the batch mode or interactively. The output may be obtained as ASCII text files which may be transferred to CDG or placed into an ICS database.

6. **Plotting of Data into Graphics Files**.

The ICS program enables the selective plotting of points and figures into a graphics file. This may be accomplished with or without the file actively displayed at a graphics terminal. The plotted points may be used for additional graphic design, and the new points may be stored in the database.

7. <u>Output into data files</u>.

Output files may be created while the ICS program is active. They may be used as a record of the computations performed while the program is active or they may be used as a table of the point and graphic elements included in the database.

Output files consist of ASCII text files with a nine character file name followed by a three character extension.

8. <u>Transfer of Data to CDG</u>.

The procedure for transfer of data files from RTK to CDG is similar to that of transferring data files from CDG to RTK. Any ASCII text files are suitable for transfer. These may consist of converted output from ISP.EXE, PLANE.EXE or an ICS database.

9. <u>Graphics File Arrangements</u>.

Several methods are available for arranging graphics files using Intergraph software. These arrangements make use of "reference files" in which several discrete files of graphic data may be joined together for display at the terminal or for plotting, while the graphic elements themselves are protected from being deleted or revised.

Reference file arrangements are analogous to drawings which have been prepared on multiple layers of transparent film. The films may be translated or rotated with respect to one another while the drawing data itself remains fixed to the film on which it was drawn. The computer files, however, may also be scaled with respect to one another.

Graphics files each contain a coordinate system which may be set to any desired range of values. Once the origin is defined, all points within the file, take on the appropriate coordinate values within the file. Files may therefore be set for the ISP coordinate system or the State plane coordinate system.

Two basic techniques for using graphics files for locating the footprints stand out as being the most advantageous. The first method is appropriate for conceptual design of the footprint at the selected site and may be termed the "Approximate Method". The second method is appropriate for precise determination of the footprint in the State plane coordinate system. The approximate method will yield coordinate values which are within 1.5 feet of the exact values. The precise method can yield coordinates which are accurate within 0.0003 feet of the true value. This is well within the required accuracy for land acquisition.

10. **Approximate Footprint Positioning.**

This method uses a footprint file in the ISP coordinate system which is attached as a reference file along with a second reference file containing the graphic data base for the site in the State plane coordinate system. The footprint is not converted point by point into the State plane coordinate system. Instead the reference file is scaled and rotated to represent its position at the site. The source of the approximation is the fact that one scale factor must be used for the whole footprint. This factor is only exact for the latitude of the center of the footprint. Points north of the footprint are too far apart and points south of the footprint are too close together. The error would be more than 1.5 feet.

11. **Precise Footprint Positioning.**

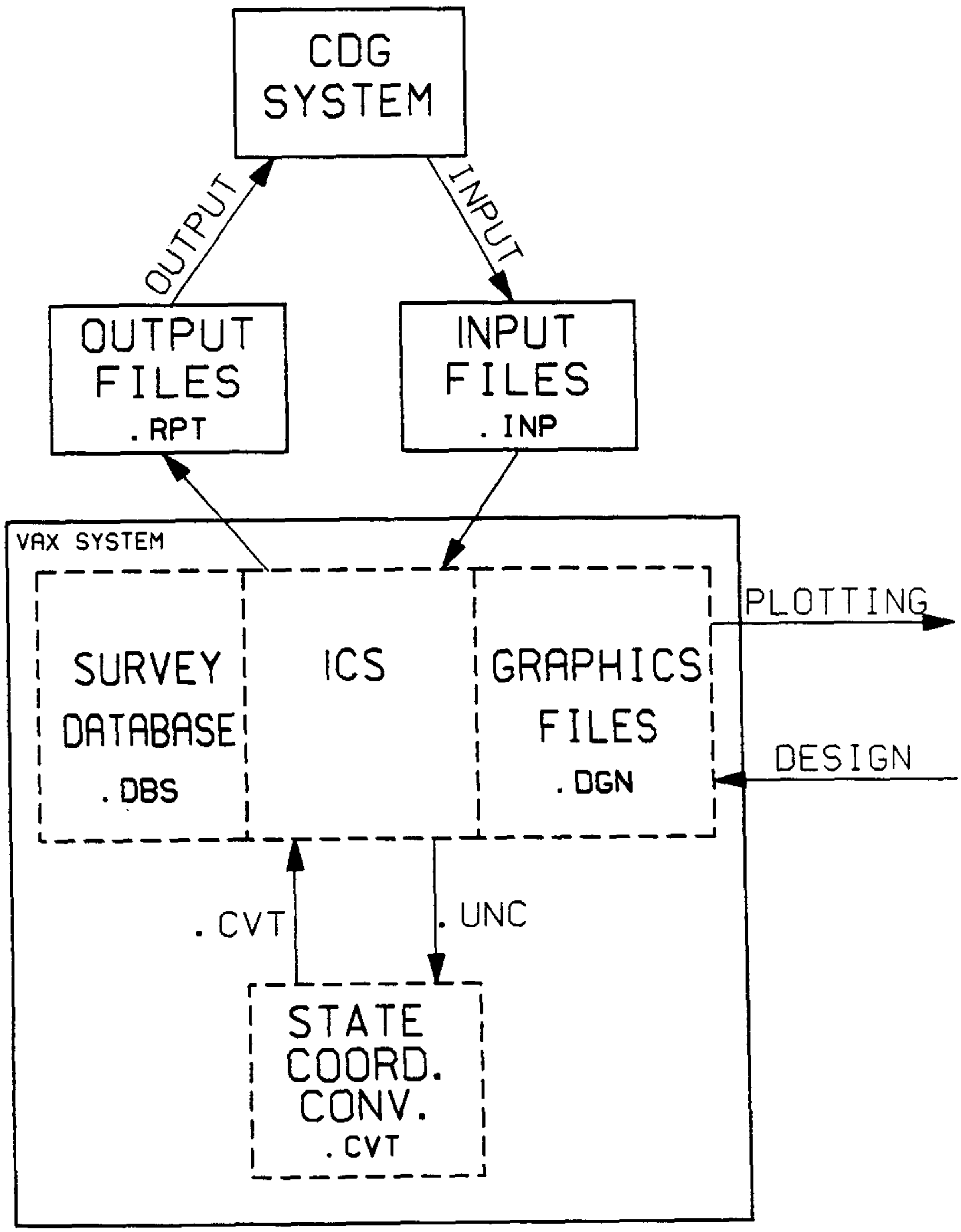
In order to obtain a precise layout of the footprint in a graphics file, the data may be converted point by point into the State plane coordinate system. The converted points would be plotted into a file in the State plane coordinate system. This file would be attached using a one to one scale ratio to the plotting file. Points would be connected by lines defining the boundary of the footprint after conversion. Coordinate geometry software would be used for this file preparation. The resulting points will be accurate within 0.0003 feet of the true value. Higher accuracy can be obtained from graphics files by limiting the area covered by the file. The current recommended graphics file units of resolution is 3,048 units per foot.

12. **Documentation of Graphics Files.**

Selected combinations of reference files may at any time be copied into discrete files in order to serve as a record of a footprint sited within the map database. These files may be taped and filed as a permanent record while the active files are further manipulated.

MRJ:gmj11

SURVEY DATA TRANSFER



DETERMINATION OF SSC FOOTPRINT IN STATE PLANE COORDINATE SYSTEMS

The following procedure describes the steps required to define the SSC Project land area boundary and other significant points at a specific site, using the State plane coordinate system.

1. Approximately 1,000 coordinates will be determined by the Central Design Group for the location of the lattice. The coordinates will be based on the ISP Coordinate System which consists of a rectilinear system with axes designated as X and Y. The center of the system is assumed to be at X-100,000 and Y-100,000.

2. Coordinates will be stored on magnetic tape in an ASCII text file consisting of serial point numbers followed by the Y-coordinate, X-coordinate, Z-coordinate respectively.

3. Coordinates will be transferred to a database file compatible with the Intergraph program; ICS (Interactive Coordinate Geometry Subsystem).

4. Lattice coordinates will be used to calculate two additional sets of coordinates. The first new set will represent the inside boundary of the land area requirement and will consist of points 150 feet from the corresponding lattice points. The second new set of points will represent the outside boundary of the land area requirement and will consist of points 850 feet or 1150 feet from the corresponding lattice point depending on where the points are located with respect to the G, H or D areas. The resulting three sets of coordinates will be based on the ISP Coordinate System and will be used to define the G, H and D areas.

5. Additional coordinate values will be added to these sets to represent the boundaries of the A, B, C, I, and J areas. These values will be based on the ISP Footprint dimensions modified if necessary by the three sets of coordinates along the lattice. The locations of the E, F, K, and L areas will be based on selected coordinates along the lattice.

6. All resulting coordinates will be copied from the database into an ASCII text, output file.

7. The above values will be converted to the State plane coordinate system using the following sequence of computations:

8. The "left" boundary of the I area was defined by first determining the intersection with the Y axis of two points, 2045 and 2046, above and below the axis. The intersection point, 927 was used to determine the upper and lower apices of the I area by locating points 928 and 929 a distance of 38,680 ft. above and below point 927 with the same X-coordinate.

9. The upper and lower I area boundaries were selected as lines from point 928 to 2177 and from point 929 to 2791.

10. The upper outer G area boundary was modified by extending a line from point 2175 through 2176 to its intersection the line from 928 to 2177.

11. The lower G area boundary was modified by extending a line from point 2793 through 2792 to its intersection with the line from point 929 to 2791.

12. The J areas were located as sets of four corner points numbered 932 through 955. Coordinates were determined using ISP Footprint dimensions beginning from point 927.

13. E and F areas were located as follows:

Boundary	Location
E3	Centered on B/C.
F3	Centered on C50.
E4	Centered on C/D.
F4	Centered on D50.
E5	Near ISP location.
F5	Near ISP location.
E6	Near ISP location.
F6	Centered on E50.
E7	Centered on E/F.
F7	Centered on F50.
E8	Centered on F/G.
F8	Centered on G50.
E9	Centered on G/H.
F9	Centered on H50.
E10	Near ISP location.
F10	Near ISP location.
E1	Near ISP location
F1	Centered on A50.
E2	Entered on AB.
F2	Centered on B50.

MJ:gmj9

SSC PROJECT
DIGITAL FOOTPRINT

DEVELOPMENT OF BOUNDARY COORDINATES

The boundary coordinates which may be used to define the land area requirements for the project were calculated according the following procedure using 834 points along the lattice.

1. Points along the lattice, numbered 1 through 834 were obtained from the text file LIGHTSUR.DAT. The file was copied and the copy was edited to conform to requirements for an input file for the ICS database. This consists of removing all text above the coordinate list, adding the word "STORE" above the list and removing the columns for the S-Index and Angle (Theta). The file was named LIGHTSUR.OUT.

2. A graphics file, GENERIC.DGN was prepared for plotting coordinates and figures. ICS software was accessed while displaying the graphics file. The database, TEMPLATE.DBS was attached to the graphics file. The file name "GENERIC" was changed to "DIGITAL".

3. The lattice coordinates were placed in the database using the INPUT FILE command followed by LIGHTSUR.OUT.

4. Inner boundary coordinates were computed using the PARALLEL FIGURE command. This resulted in points numbered 1001 through 1834 which define a figure 150 ft. inside from the lattice points. The resulting inner boundary includes the outer boundary of the bypass area.

5. Outer boundaries were calculated using the same procedure as in Item 4. Distances of 850 ft. and 1150 ft. were used in the appropriate regions. The regions consist of the points listed in the Figure Table for Figure 3 through 7. Outside points are numbered 2001 through 2834.

6. Points on the ISP Footprint boundary were assigned numbers 901 through 923.

7. The inner bypass area boundary was determined after noting that the outer bypass area points fall very close to the ISP Footprint boundary in that area. It was assumed that the inner bypass boundary points may be calculated as points along the ISP Footprint are which has a radius of 111,165 ft. This arc was used to calculate 88 points on the arc plus two points at the upper and lower intersection of the bypass arc and the inner ring.

a) The State plane coordinates of the center of the footprint will be established by the State and used as the basis for the location of the footprint at the specific site.

b) The grid azimuth of the positive Y-axis in the ISP coordinate system will be established by the State and used as the basis for the orientation of the footprint.

c) The sea level factor for the site will be calculated based on an assumed ground elevation.

d) The footprint coordinate list will be processed by a computer program designed to translate, rotate and scale each coordinate for conversion into the State plane system. The rotation and translation will be computed by elementary, two dimensional equations. The scaling of the coordinates will be accomplished by the following procedure:

(1) Using the center of the footprint (X-100,000, Y-100,000) as a station point, each set of coordinates will be converted into an azimuth and distance from the station point.

(2) The grid factor for the end points and midpoints of each line will be computed.

(3) The grid factor for the line will be computed by Simpson's rule based on the values obtained in Item (2) above.

(4) The combination factor for the line will be computed based on the sea level factor and the grid factor.

(5) Each line will be scaled and, holding the azimuth constant, the State plane coordinates will be derived by converting the scaled distance and azimuth back into X and Y coordinates.

8. Output from the conversion program will be stored in an ASCII text file and entered back into the survey database for plotting and subsequent computations.

MJ:gmj8