27/9-9-83 JS ①

I-11068

SANDIA REPORT

SAND82-2800 • Unlimited Release • UC-13

Printed December 1982

A Wire Frame to MOVIE.BYU Transfer Program

Donald Robbins, Leland D. Byers, Mark S. Benner

DO NOT MICROFILM
THIS PAGE

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550
for the United States Department of Energy
under Contract DE-AC04-76DP00789

MASTER

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

DO NOT MICROFILM
THIS PAGE

Issued by Sandia National Laboratories, operated for the United States Department of Energy by Sandia Corporation.

NOTICE: This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government, any agency thereof or any of their contractors or subcontractors. The views and opinions expressed herein do not necessarily state or reflect those of the United States Government, any agency thereof or any of their contractors or subcontractors.

Printed in the United States of America
Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

NTIS price codes
Printed copy: A03
Microfiche copy: A01

PAGES 1 to 2

WERE INTENTIONALLY
LEFT BLANK

SAND--82-2800

DE83 017497

SAND82-2800
Unlimited Release
Printed December 1982

A WIRE FRAME TO MOVIE.BYU
TRANSFER PROGRAM

Donald Robbins
Computer Aids Systems Development Division

Leland D Byers
Project Design Definition Division VI &
Software Development

Mark S Benner
Physical Standards Division

Sandia Laboratories
Albuquerque, NM 87185

ABSTRACT

At SNLA, the primary computer-aided drafting tool is the Applicon Graphics System (AGS). The data base for mechanical parts on the AGS is a "wire frame" model. This report summarizes a method of adding surface information to the wire frame and passing this information "up stream" to MOVIE.BYU which is on a VAX computer and is used to produce shaded graphics pictures of the AGS wire frame model on a RAMTEK 9400 display terminal.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Reg

CONTENTS

	<u>Page</u>
1.0 Introduction	6
2.0 The Procedure	6
2.1 AGS Surface Definition	6
2.2 Binary to APPLE	7
2.3 Abstraction of Surface Information	7
2.4 Post Processing	8
2.5 MOVIE.BYU	8
3.0 Other Thoughts	9
3.1 Data Overflow	9
3.2 Use with B61	9
3.3 Black and white pictures	9
3.4 Scissors	9
3.5 Viewpoint	9
4.0 Conclusions	10
5.0 Acknowledgments	10
6.0 Documentation	11
6.1 VAX ROOT Directory	11
6.2 Subdirectory .IO121]	11
6.3 Subdirectory .TSTAPL]	11
6.4 Subdirectory .GEN]	11
7.0 References	12
Appendix A - Making the Wire Frame Solid	13
Appendix B - AGS Instructions	18
Appendix C - The @AGS2BYU Example	20
Appendix D - Pictures and Examples	24
8.0 Distribution	29

1.0 Introduction

What follows is the documentation, programs, and linkage to produce a MOVIE.BYU (ref 1) file from a drawing produced on the Applicon AGS (ref 2).

This project could be paraphrased as "Making the Wire Frame Solid". As a matter of fact, a paper (Appendix A) was presented on this topic to the 19th Design Automation Conference. This paper gives an overview of the rationale for the procedure.

2.0 The Procedure

The procedures for doing the process are contained under topic 2. The AGS procedures are listed in Appendix B. The detailed listings are contained in the microfiche.

2.1 AGS Surface Designation

At the AGS terminal, running the 3D system, surfaces are designated by using unique component names. Two "solids" used are the: 1) surface of revolution, and 2) the slab. The surface of revolution uses a component designation of QZR1. The slab is designated by: 1) a polyarc using QZP1 and a thickness designated by QZN1. This thickness doesn't necessarily have to be normal to the polyarc, but it does need to touch the polyarc at some place.

Also at Sandia we use the Ramtek 9400 (ref 3) for the display of the colored shaded graphics parts. To take care of the classification aspects, yet a fourth component designation is used. This is QZT1. This component contains both the part name and the classification. Before the picture can be displayed on the Ramtek, this component must be present and of the proper form.

This component QZT1 is specialized for the Sandia environment. For other output media, it is not required.

2.2 Binary to APPLE

From the 3D binary drawing file, the need is to produce an APPLE file.

At Sandia the procedure is as follows:

- 1) The 3D binary drawing file is moved to the RSX side of the IMAGE system.
- 2) The Sandia Network is used to transfer the 3D binary file to VAX (ref 4,5).
- 3) The 3D binary file to APPLE translator program is run to effect the conversion. This program performs the function of IO121 (ref 6), but is much faster since it is run on the VAX.

2.3 Abstraction of Surface Information

The AP3GCS program reads a drawing data file in APPLE ASCII format and produces a plot file for the drawing.

The source code for this program was segmented into five parts for easier handling. The five parts are: 1) TSTAPL2 (the main program), 2) DECOMP, 3) DOPLT, 4) OTHER, and 5) REST. A search for components named QZP1, QZR1, and QZN1 was added to DOPLT.

The APPLE input is on unit FOR007.DAT and the abstracted information is on FOR008.DAT. The program runs on the Tektronix and there are several questions to answer.

The modified program listing is included in the microfilm attachment.

2.4 Post Processing

The file produced by the program above is post processed by RED8. This program, among other things, associates the QZN1 "normals" with the proper polyarc (the QZP1). The output of this program is on unit FOR009.DAT.

The listing of this program is included in the microfiche.

The last remaining job is to cast the coordinate information into MOVIE.BYU format. The program GEN1 does this. The input is on FOR009.DAT and the MOVIE.BYU format file is on FOR011.DAT.

2.5 MOVIE.BYU

When a surface of revolution is used, a lot of parts will be generated. The version of MOVIE.BYU we are using allows only 20 parts.

What can be done when more than 20 parts are generated is to go into the MOVIE.BYU file (FOR011.DAT) with the Editor and coalesce some of the parts into one.

This involves changing the overall totals in the first line and the nodes which make up the part in the next few lines. An example of this is shown in Appendix C.

The resulting file is then processed by MOVIE.BYU. Hidden lines can be removed, or shaded graphics produced. An example is shown in Appendix D.

3.0 Other thoughts

3.1 Data Overflow

A surface of revolution generates a lot of polygons. If the part to be modeled has many surfaces of revolution, the data structures of MOVIE.BYU will overflow.

3.2 Use with B61

The use we have made of this technique was with the B61.

We produced life size shaded black and white pictures of each of the piece parts of the B61. These parts were produced separately and assembled separately. In this way the overflow problem mentioned in 3.1 was avoided.

3.3 Black and white pictures

Color output is possible from the Ramtek 9400. However we found we could get better resolution in black and white than in color. Since we were enlarging the B61 parts to life size, we needed the additional resolution.

3.4 Scissors

We used scissors to cut out each of the parts from the enlargements. These parts were then placed on a display board. A photo was taken of this display board.

The B61 has parts which are classified. The classified picture is in the possession of K. E. Wiegandt, 2457.

3.5 Viewpoint

The views were made with a 30 degree rotation around the Y axis. The axis of the B61 is along the X-axis.

The views which come from MOVIE.BYU are perspective. With an assembly, in the manner in which each part was produced, the different perspective vanishing points are disconcerting to some.

In MOVIE.BYU it is possible to minimize this effect. What is done is to increase the distance to the object, and then to enlarge the resulting image. This effectively removes the perspective vanishing point.

4.0 Conclusion

The technique is easy to use, involving little time on the AGS side. The series of programs flow together, linked with a VAX command procedure. The command procedure is listed in Appendix C.

This is a useful adjunct for a 3D mechanical part which already exists in Applicon form.

5.0 Acknowledgments

The contributions of many other people are acknowledged, including: Lee Toliver, who wrote the AP3GCS code; Bill Burd, who wrote the VAXAPPLE3D program; and Carol Jones, who added to QZT1 software.

6.0 Documentation

6.1 VAX ROOT Directory

The root directory on the VAX is:

DR3:[ROBBINS.AGS2BYU]

This directory contains 3 sub directories for the running and maintenance of the system.

This directory contains the command file for coupling the sequence of programs together. It is called AGS2BYU.COM. There are also command files for saving the programs to tape and for restoring from tape.

6.2 Subdirectory .IO121]

This subdirectory contains the program which does the AGS binary file to APPLE translation. This is the equivalent of IO121 on the AGS system.

6.3 Subdirectory .TSTAPL]

This subdirectory contains the modified AP3GCS program to abstract the slab and surface of revolution components from the APPLE file. It is called TSTAPL2.EXE.

6.4 Subdirectory .GEN]

This subdirectory contains RED8 which associates the thickness with the slab.

Also GEN1 is included which generates the MOVIE.BYU format.

7.0 References

- (1) MOVIE.BYU details from Dr. Hank Christiansen, Civil Engineering, Brigham Young University, Provo, Utah, 84602
- (2) AGS/880 User's Guide, Document #A-21138, Applicon Inc., 32 Second Ave, Burlington, MA., 01803
- (3) RAMTEK - 9400, 2211 Lawson Lane, Santa Clara, Calif., 95050
- (4) General Overview of MADDS/VAX Network Support and Release Software by William C. Burd and Ann L. Yates, SAND80-2562, November, 1980 - Sandia Labs, Albuquerque, N. M., 87185
- (5) SAND82-0473 "The Organization 2400 Computer Aided Design Network Dispatcher: Phase I Description by William C. Burd, et al, page 31.
- (6) APPLE-ASCII Data Base I/O, AGS/884, IO120 and IO121, Applicon Inc., 32 Second Ave, Burlington, Mass., 01803

APPENDIX A

MAKING THE WIRE FRAME SOLID*

by Donald Robbins

Division 2424
Sandia National Laboratories
Albuquerque, NM 87185

Abstract

At SNLA, the primary computer-aided drafting tool is the Applicon Graphics System (AGS). The data base for mechanical parts on the AGS is a "wire frame" model. Experiments are underway for adding surface information to the wire frame and passing this information "up stream" to a VAX computer.

On this computer, a programming system for manipulating polygonal information (MOVIE.BYU) is available. One of the output devices is a RAMTEK 9400 high resolution color display. This display has also been interfaced to a color recorder.

Introduction

One of the uses of graphics has been to improve the understanding of what is being presented. For instance, a graph from a table of numbers enables relationships to be better understood.

In mechanical design, a solid object is visualized by the design engineer. In an industrial enterprise, the designer communicates the design to the drafter via sketches, talking, gestures, relations to similar parts, etc. The drafter then makes a drawing with (for instance) a front view, side view, and top view in an attempt to reduce the 3-dimensional object to a representable object in 2 dimensions (the sheet of paper). This drawing is now the communication vehicle. The design engineer talks to the drafter about refinements, using the drawing as the communication media.

The drawing, after as many iterations as time and money allow, is then used in the manufacturing and testing sequences. Also it is the archival device for future reference.

The so called turnkey drawing systems, such as Applicon, Calma, and Computer Vision are used by industry to mechanize the drafting process.

* This work was supported by the United States Department of Energy.

In these machines, the part is generally represented by a wire frame model, where the coordinates (in three space) of the nodes are available, as well as a representation of which nodes are connected to make the wire frame.

With information in this form, it is possible to rotate, translate, project, and scale the wire frame to produce different representations. All of these representations are used to aid in the understanding of the object from different 2 dimensional presentations.

A New Presentation

The purpose of this paper is to describe a procedure for a new representation of the wire frame information.

The device used for the work is the Applicon Graphics System (AGS) (1). The target system is the software system on the VAX-11/780 (2) called MOVIE.BYU (3). The display device is the RAMTEK 9400 (4) and the recording device is the Matrix (5).

The Process

A. Surface Information

The wire frame model on the AGS typically does not have explicit surface information. This is really the crux of this procedure - that of designating surfaces.

Two approaches have been used.

FIGURE 1 - BASE PLATE AIM MESHING

One approach is to use AIM (6), a finite mesh generation program, to designate the surfaces. Figure 1 is the output from meshing a part. Note that only simply connected parts are allowed so holes have to be included in the manner shown.

FIGURE 2 - BRACKET WITH CONSTRUCTION LINES FROM POLYARC

The second approach is to create a "polyarc" of a simply connected surface. The term polyarc is Applicon lingo for a "line" which consists of straight line segments and arcs which share common vertexes. Depth information is added and a drawing like Figure 2 results.

FIGURE 3 - SURFACE OF REVOLUTION FROM AGS

Figure 3 is output from a surface of revolution construct on the AGS.

These then are two methods for designating surfaces in the Applicon system. The same technique should be applicable to any wire frame model on a turnkey system.

B. Moving Information Upstream.

There exists on the AGS sort of a neutral file system called the APPLE format (7). This is a complete representation in ASCII of the internal binary file structure. This file is produced from the drawing file. The surface information produced by either of the two above methods has special labels on it.

One method that has been used at Sandia is to create the APPLE file on the AGS. The file is then transferred to the RSX side of AGS. From there it can be moved to the concentrator via DECNET and from there to the VAX-11/730 again via DECNET. Details of the network are contained in a Sandia internal document (8).

C. MOVIE.BYU

This programming system manipulates polygon information. A polygon is defined by a set of nodes and a set of connectivities. That is exactly what is available from AGS.

A convert program is run to parse and abstract the pertinent information from the APPLE file.

Two methods of generation are possible. Information may be encoded directly into the input format of MOVIE.BYU, or the generation routines in a MOVIE.BYU program called Utility may be used.

In any event, once into the MOVIE.BYU format, the many elegancies of the system can be used.

FIGURE 4 - TORCH HOUSING

Plots can be made, as in Figure 4. This is how the wire frame model looks. Some may consider it an improvement over the front, top, side views.

FIGURE 5 - TORCH HOUSING WITH HIDDEN LINES REMOVED

MOVIE.BYU can remove the hidden lines, thereby greatly enhancing the viewability. Figure 5 is the result. There is still an artifact which is objectionable. The top surface is created from a lot of small parallel polygons, which give the appearance of forming part of the wall. Removing the top results in Figure 6.

FIGURE 6 - TORCH HOUSING WITH TOP REMOVED AND WITH HIDDEN LINES REMOVED SK 2

When the shaded graphics of MOVIE.BYU are used however, this visual ambiguity is removed. Figure 7 is output from a Polaroid camera attached to the Matrix Instruments color film recorder, looking at the image on the RAMTEK 9400.

FIGURE 7 - SHADED COLOR GRAPHICS OF TORCH HOUSING

D. A Walk Thru

It may aid in the understanding of the process if a technical walk thru is described.

1. The drafter, at a turnkey drafting system (an Applicon at Sandia National Labs in Albuquerque) calls up a drawing at the AGS terminal. This drawing consists of a wire frame representation of the object. At the terminal, it is possible to manipulate the object in a wide variety of ways. The drafter will designate a surface by selecting the perimeter and "traversing" it in a counter clockwise sense. This provides (implicitly) the sense of what is inside and outside the surface of

an object. This new object (the surface) is created with an uniquely named line (QZP1). The thickness of the surface is attached to the line as a label (like Z = 2.34 INCHES).

Since MOVIE.BYU (currently) doesn't allow holes (explicitly), a surface, with a hole, is treated as two surfaces as is shown in some of the figures. This is sort of a bother, but on the other hand, picking out surface information from the welter of wire frame lines, dimension and construction lines, is sort of a bother.

This interaction at the terminal level, is really the last place the human has to intervene in the process. These terminals are designed to aid in human interaction and so the process goes quickly.

2. Next (at Sandia) this drawing, represented in the internal file format of the Applicon system is converted on the Applicon system to an external ASCII format (called an APPLE file). All of the drawing information is preserved in this transformation (this converter is also available on the VAX so it is possible to do the conversion on a more powerful machine if desired).

The ASCII file is now sent to the VAX. The transfer can be via a communication link (if one exists) or by tape.

3. On VAX, a plotter program exists for producing a line drawing from an APPLE file. This program was minimally modified to look for polyarcs created with line QZP1. This information is abstracted and a file produced containing it (the coordinates of the vertexes and the connections).

4. Another small program converts this file information to the input style needed by MOVIE.BYU.

5. In summary, the development effort needed was:

- a. A protocol for designating surfaces in a wire frame world,
- b. A mechanism for extracting this connectivity and coordinate information from a large drawing file,
- c. A recasting into a suitable form for MOVIE.BYU.

Program Details

A. Interactive protocol

A mechanism is needed to designate a surface in the turnkey interactive world. On the Applicon system at Sandia a poly- arc was used, created with a uniquely named line component. Thickness information was also added,

B. Finder program

The information on surfaces is gleaned from the drawing file. At Sandia, the converted file, APPLE was used, looking for the uniquely named component. The same approach could be used to obtain the information from the internal file structure.

C. Converter

The vertex coordinates and the connectivity information is recast into the MOVIE.BYU format with a small conversion program written in Fortran.

D. MOVIE.BYU

MOVIE.BYU has been developing over quite a few years. It has many output options available as well as many capabilities for object manipulation. There have been implementations on many mainframes as well as on 16 bit machines.

Conclusion

This process is fast and can be used to aid in visualization. The color shaded graphics output is of photo quality, produced from a part which exists in internal machineable form.

Since we are accustomed to looking at pictures (still in general 2 dimensional) but with depth information implicit from shading and high lights of lighting, this output from a wire frame "solid" is natural to our perception.

REFERENCES

- (1) AGS/880 User's Guide, Document A-21128, Applicon Inc., 32 Second Ave, Burlington, MA., 01803
- (2) VAX 11/780 from Digital Equipment Corp., Maynard, Mass., 01754
- (3) MOVIE.BYU details from Dr. Hank Christiansen, Civil Engineering, Brigham Young University, Provo, Utah, 84602
- (4) RAMTEK - 9400, 2211 Lawson Lane, Santa Clara, Calif., 95050
- (5) Matrix Instruments Model 4007 Color Graphics Camera, 230 Pegasus Ave., Northvale, New Jersey, 07647

(6) Finite Element Modeling, Applicon Interactive Modeler, AIM, AGS/843, Applicon Inc., 32 Secnd Ave, Burlington, Mass., 01803

(7) APPLE-ASCII Data Base I/O, AGS/884, IO120 and IO121, Applicon Inc., 32 Secnd Ave, Burlington, Mass., 01803

(8) General Overview of MADDS/VAX Network Support and Release Software by William C. Burd and Ann L. Yates, SAND80-2562, November, 1980 - Sandia Labs, Albuquerque, N. M., 87185

A P P E N D I X B

AGS Instructions

I. Introduction

This Appendix contains information on the creation of the surface information on the 3D Applicon system.

These instructions assume the user has a good working knowledge of the 3D Applicon Graphics System.

II. Getting Started

- A. Log into an Applicon 3D work station,
- B. Execute WIPE; YES <CR> !This clears the terminal
- C. LOAD PART3D[3D] <CR> !this obtains a start file.

Two solids can be sent "Upstream" to the VAX. These are: 1) the Surface of Revolution, and 2) the slab.

Also for Sandia Use, a text record is required.

These need to be defined with primitives having the unique names listed below.

Name	Type	Use
QZP1	Polyarc	Outline of slab
QZN1	Polyarc	Thickness of slab
QZR1	Rev	Surface of Revolution
QZT1	Polyarc	Text node

III. Instructions for creating and using these primitives

- A. Create QZP1 from the existing PA component with ECMP QZP1 PA @ @ @ @ @ <CR>. QZP1 is used to define the outline of the slab and needs to be one continuous component with the start and end points having the same X, Y, Z coordinates. If it is not continuous, the JOIN command should be executed to do this. Also arcs can be included. The polyarc needs to be planar.

Only simple surfaces can be processed in the present version of MOVIE.BYU. This means holes have to be treated by creating a construction line to the hole, going around the hole, and then back out.

- B. Create QZN1 from the existing PA component with
ECMP QZN1 PA @ @ @ @ @ <CR>. QZN1 defines the thickness of the slab but does not necessarily have to be normal to QZP1. However it does need to touch QZP1 at some point. When added to the file, this line will have only two vertices.
- C. Create QZR1 by typing ECMP QZR1 REV 30 Y 1 <CR>. Surfaces of Revolution are created with this QZR1 primitive. Volume II, Chapter 8, of the Applicon AGS/880 User's Guide contains an explanation on how to create a surface of revolution. One item that is not obvious in this explanation is that the defining arc can be any angle and does not necessarily have to be a full 360 degree circle.
- D. Create QZT1 from the existing PA component with
ECMP QZT1 PA @ @ @ @ @ <CR>. QZT1 is the primitive that identifying text should be attached to. Two lines of text can be added to this component. One line for part number or name and the other line for classification: 1) unclassified, 2) confidential, or 3) secret. The part name should be 30 characters or less.

EXAMPLE

Bushing	or	Unclassified
Unclassified		Bushing

IV. Transferring the AGS file to VAX.

All unused definitions may be deleted from the file using the DDEF U command. This is advisable but not mandatory for subsequent processing. Following execution of DDEF U, the SORT and FIX commands should be executed in EDIT mode. The file should then be stored with an appropriate file name.

To transfer the file to the RSX side use IO 70. The command is IO 70 0 0 0 0 0 0 0 RS FILENAME [200,223]FILENAME.DAT

The file can be transferred to VAX using TFILE on the concentrator or NETGETNC from VAX.

A P P E N D I X C

@AGS2BYU Examples

```

$ @AGS2BYU CCASEV1.DAT
VAXAPPLE3 Version 1.009 8-Mar-82
number of polytext components = 0
end of VAXAPPLE3
UD3:[CROBBINS.AGS2BYU.TSTAPL]
$RUN TSTAPL2

```

APLIN-3D *** VERSION 1.1

```

LOGICAL RECORDS ..... 12
PHYSICAL RECORDS ..... 4

COMPONENT DEFINITIONS ..... 2
CONSISTING OF PATH ..... 0
                PR ..... 1
                IL ..... 0
                CELLS ..... 0
                POLYSPLINES ..... 0
                RULED ..... 0
                WARPED ..... 0
                UNDEFINED ..... 0
                SURF REV ..... 1
                POLYTEXT ..... 0

COMPONENT PLACEMENTS ..... 4

NEXT FREE COAT ADDRESS ..... 1
NEXT FREE CHAM ADDRESS ... 4

```

APL3D-GCS POSTPROCESSOR *** VERSION 1.1

FILE TYPE = P3D0

FILE VERSION =
PRESS RETURN TO CONTINUE

← (CR)

```

HOW MANY LEVELS TO BE VIEWED?(1-16)
ENTER LEVELS TO BE VIEWED,1-16
ENTER VIEW(S) WANTED
FRONT,RIGHT,LEFT,TOP,BOTTOM,AFT,PERSPECTIVE,ISOMETRIC
ENTER FIRST LETTER OF EACH
COMBINE VIEWS?(Y-N)
ENTER X,Y,Z COORD. OF VIEWERS EYE
ENTER X,Y,Z COORD. OF OBJECT SEEN
ENTER WIDTH OF VIEW

```

194

GCS-W-GCSERROR, Gcs error number 194

ZNONAME-W-NOMSG, Message number 00000000

XTRACE-W-TRACEBACK, symbolic stack dump follows

module name	routine name	line	rel PC	abs PC
-------------	--------------	------	--------	--------

GCSTBK GCSTBK
 GCSERR GCSERR
 U3WINDO U3WINDO
 DOPLT DOPLT
 TSTAPL2 TSTAPL2
 MORE TO THIS JOB?(Y-N)

72 0000003F 0020C323
 85 000000A7 0020AF5B
 84 000000CD 002092F9
 190 00000446 00202C76
 117 000003CD 002003CD

← (CR)

FORTRAN STOP
 \$SET NOVERIFY
 UD3:KROBBINS.AGS2BYU.GENJ
 \$RUN RED8
 EOJ
 \$RUN GEN1
 PANELS ONLY ON SURF OF REV - Y/N

END OF GEN1

\$SET NOVERIFY
 \$ TY FOR011.DAT

143 3706 1716 6888
 1 12 13 24 25 36 37 48 49 60 61 72 73 84 85 96
 97 108 109 120 121 132 133 144 145 156 157 168 169 180 181 192
 193 204 205 216 217 228 229 240 241 252 253 264 265 276 277 288
 289 300 301 312 313 324 325 336 337 348 349 360 361 372 373 384
 385 396 397 408 409 420 421 432 433 444 445 456 457 468 469 480
 481 492 493 504 505 516 517 528 529 540 541 552 553 564 565 576
 577 588 589 600 601 612 613 624 625 636 637 648 649 660 661 672
 673 684 685 696 697 708 709 720 721 732 733 744 745 756 757 768
 769 780 781 792 793 804 805 816 817 828 829 840 841 852 853 864
 865 876 877 888 889 900 901 912 913 924 925 936 937 948 949 960
 961 972 973 984 985 996 997 1008 1009 1020 1021 1032 1033 1044 1045 1056
 1057 1068 1069 1080 1081 1092 1093 1104 1105 1116 1117 1128 1129 1140 1141 1152
 1153 1164 1165 1176 1177 1188 1189 1200 1201 1212 1213 1224 1225 1236 1237 1248
 1249 1260 1261 1272 1273 1284 1285 1296 1297 1308 1309 1320 1321 1332 1333 1344
 1345 1356 1357 1368 1369 1380 1381 1392 1393 1404 1405 1416 1417 1428 1429 1440
 1441 1452 1453 1464 1465 1476 1477 1488 1489 1500 1501 1512 1513 1524 1525 1536
 1537 1548 1549 1560 1561 1572 1573 1584 1585 1596 1597 1608 1609 1620 1621 1632
 1633 1644 1645 1656 1657 1668 1669 1680 1681 1692 1693 1704 1705 1716
 1.53780E+02 1.33000E+02 0.00000E+00 1.53780E+02 1.15181E+02 -6.65000E+01
 1.53780E+02 6.65000E+01 -1.15181E+02 1.53780E+02 0.00000E+00 -1.33000E+02
 1.53780E+02 -6.65000E+01 -1.15181E+02 1.53780E+02 -1.15181E+02 -6.65000E+01
 1.53780E+02 -1.33000E+02 0.00000E+00 1.53780E+02 -1.15181E+02 6.65001

Y
 \$ ED FOR011.DAT
 2303

1
 143 3706 1716 6888
 S/143/ 1/F
 1 3706 1716 6888
 A
 1 1716

1 12 13 24 25 36 37 48 49 60 61 72 73 84 85 96
 97 108 109 120 121 132 133 144 145 156 157 168 169 180 181 192
 193 204 205 216 217 228 229 240 241 252 253 264 265 276 277 288
 289 300 301 312 313 324 325 336 337 348 349 360 361 372 373 384
 385 396 397 408 409 420 421 432 433 444 445 456 457 468 469 480
 481 492 493 504 505 516 517 528 529 540 541 552 553 564 565 576

577	588	589	600	601	612	613	624	625	636	637	648	649	660	661	672
673	684	685	696	697	708	709	720	721	732	733	744	745	756	757	768
769	780	781	792	793	804	805	816	817	828	829	840	841	852	853	864
865	876	877	888	889	900	901	912	913	924	925	936	937	948	949	960
961	972	973	984	985	996	997	1008	1009	1020	1021	1032	1033	1044	1045	1056
1057	1068	1069	1080	1081	1092	1093	1104	1105	1116	1117	1128	1129	1140	1141	1152
1153	1164	1165	1176	1177	1188	1189	1200	1201	1212	1213	1224	1225	1236	1237	1248
1249	1260	1261	1272	1273	1284	1285	1296	1297	1308	1309	1320	1321	1332	1333	1344
1345	1356	1357	1368	1369	1380	1381	1392	1393	1404	1405	1416	1417	1428	1429	1440
1441	1452	1453	1464	1465	1476	1477	1488	1489	1500	1501	1512	1513	1524	1525	1536
1537	1548	1549	1560	1561	1572	1573	1584	1585	1596	1597	1608	1609	1620	1621	1632
1633	1644	1645	1656	1657	1668	1669	1680	1681	1692	1693	1704	1705	1716		

=
 20
 3,20 D
 F
 FOR011.DAT
 W
 2286
 Q
 \$

APPENDIX D

Pictures and Examples

UNCLASSIFIED

CENTER CASE

C-CASE-U1

UNCLASSIFIED

BUSHING
UNCLASSIFIED

8.0 Distribution

The Bendix Corporation
Kansas City Division
P.O. Box 1159
Kansas City, MO 64141

Copy to: W. Sprague

Los Alamos National Laboratory
Division C-6

Copy to: R. L. Elliott

2400	C. F. Bild
2420	Gino Carli
2424	R. F. Davis (2)
2424	D. R. Blazek
2424	L. C. Jones (2)
2424	J. C. Kelly
2424	R. E. Parks
2424	D. P. Peterson
2424	D. K. Robbins (10)
2424	E. G. Thuman
2424	A. L. Yates
2424	File (15)
2430	W. R. Rosenberg
2450	A. R. Eiffert
2454	G. R. Urish
2457	K. E. Wiegandt (2)
2457	L. D. Byers (2)
2551	M. S. Benner (2)
3151	W. L. Garner (3)
3141	L. J. Erickson (5)
3154-3	C. Dalin for DOE/TIC (25)
7483	W. C. Burd
8270	W. A. Little; attn: J. Jones - 8274
9340	H. W. Schmitt, attn: Don Doak - 9345