UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

OCT 20 1993

MEMORANDUM FOR: Ronald L. Ballard, Chief
Geology and Engineering Branch

THRU: Keith McConnell, Section Leader
Geology/Geophysics Section
Geology and Engineering Branch

FROM: Steve McDuffie
Geology/Geophysics Section
Geology and Engineering Branch

SUBJECT: TRIP REPORT ON APPENDIX 7 MEETING WITH DOE AND CONTRACTORS TO OBSERVE DEMONSTRATIONS OF LYNX AND EARTHVISION SOFTWARE PACKAGES

On August 10-11, 1993, Don Chery of the HLWM staff, Gerry Stirewalt of CNWRA, and I travelled to Denver, CO and Las Vegas, NV for an Appendix 7 meeting with representatives of the DOE and their contractors. This meeting was requested by the NRC so that we could observe demonstrations of two software packages in use by DOE, Lynx and EarthVision. Enclosure 1 contains the agenda for the two day meeting. Lynx and EarthVision aid in the construction of 3-dimensional geologic models, and they will be used extensively during site characterization and the possible preparation of a license application. CNWRA already possesses the EarthVision software, and during the trip NRC was in the final stages of procuring it. The chief purpose of this trip was to observe the use of both software packages and to discuss the attributes of each with those individuals most familiar with them. This was to better prepare for future decisions by NRC and CNWRA on whether the Lynx software should be purchased.

August 10 was spent at the offices of SAIC in Denver; all in attendance are listed in enclosure 2. After some introductory remarks by Ardyth Simmons (DOE) and Gerry Stirewalt (CNWRA), Mark Tynan (DOE) presented DOE's Management Plan for 3-D geological modeling (handouts in enclosure 3). Apparently each contractor will develop their individual geologic models using their preference of EarthVision or Lynx (USGS does rock characteristics, stratigraphy/structure model, LLNL does geochemical model, etc.), and EG&G will integrate all the 3-D models using EarthVision. In discussion following Mark Tynan's presentation, representatives of the USGS and their contractors contended that some modeling tasks are better suited for Lynx, while others are more appropriate for EarthVision.

Rick Spengler (USGS) gave a brief presentation on the use of Lynx by the Rock Characteristics Section of the USGS. His group is using the package to create a geologic framework, or stratigraphic reference section, into which other models (geochemical, hydrologic, etc.) can be incorporated. David Buesch of the USGS gave a slide presentation detailing the process of 3-D geologic model construction with Lynx. An important point which came out in this

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presentation is that Lynx can only display a series of fence diagrams, giving a "2 1/2-Dimensional" view; a display package called Wavefront is necessary to produce 3-D images from Lynx models. After Buesch, Chris Rautman gave a presentation on the integration of Sandia and USGS modeling efforts. Rautman models rock material properties, and he is pursuing the possibility of using the Lynx graphic capabilities to display his results.

The next presentation was by Jim Nelson of SAIC, the most knowledgeable Lynx user present. He outlined the strengths and weaknesses of Lynx, which are summarized on his handout (enclosure 4). Key assets of Lynx include the flexibility of input/output and interfacing, as well as the engineering geology capabilities. During this presentation Rick Spengler stated that Lynx is superior to EarthVision in accommodating faults into 3-D models, though supposedly EarthVision 2 due in January 1994 will have improvements in this regard. Nelson noted that the Lynx 3-D display capabilities and the lack of a graphical user interface are drawbacks of the system.

After lunch we observed two computer demonstrations. Chris Rautman's demonstration was only indirectly related to Lynx; he detailed the process by which he generates statistical data. He plans to eventually add his statistical data on rock properties to the geologic framework model developed by Spengler's group. Jim Nelson then demonstrated user interface with Lynx. As an example, he showed the process by which a secondary cross section is generated from two existing sections. Defining such cross sections is part of the process of constructing a 3-D model with Lynx. The day ended after a closing discussion among a subset of the original participants.

The second day of the meeting, slated to focus on EarthVision, was held at the EG&G offices in Las Vegas. In addition to NRC and CNWRA staff, Ardyth Simmons, Tracy Felger, Tom Bjerstedt, John Gauthier, Mark Tynan and Dave Brickey were present. We began with a discussion about EarthVision. One point which garnered much attention is the proprietary gridding methodology used by EarthVision. Stirewalt asked about precedents for using proprietary codes in the licensing process, and according to Gauthier the Defense Department has set a precedent for not releasing proprietary codes.

Several hours were spent observing Dave Brickey's demonstration of many EarthVision capabilities. Obvious attributes are the menu-driven user interface and the real-time, 3-D display capabilities. In addition, the ability to enlarge a portion of a 3-D image is quite useful. The package was also impressive in its ability to make contour maps and isopachs. Later in the day the discussion and demonstration migrated toward Geographic Information Systems, specifically Arcinfo and Arcview. Brickey took an hour or so to demonstrate Arcview to those who were interested.

Lynx and EarthVision are similar in that they are both 3-D geologic modeling systems. However, they have significant differences. Meeting participants agreed that it is best not to look at one package as superior to the other. Rather, each has its strengths and weaknesses. All who have worked with either system agree that both require significant commitments of personnel time. An estimate is one FTE just to maintain either system, and additional staff time for constructing the models. It does appear that these systems will greatly enhance DOE's ability to construct and present geologic

models. Quite possibly, they will play a significant role in the licensing process.

If there are questions regarding this report, I can be reached on 504-3460.

/Signed/
Stephen McDuffie

Attachments: As stated

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A: LYNXTRIP.REP

DOE-NRC APPENDIX 7 MEETING

AUGUST 10, 1993

U.S. GEOLOGICAL SURVEY, DENVER CO
DENVER WEST OFFICE PARK, SAIC BUILDING #52 SECOND FLOOR

8:00	•	DISCUSSION OF LYNX PACKAGE	USGS
	•	DEMONSTRATION OF LYNX PACKAGE	
12:00	LUNCH		
1:00	•	DISCUSSION OF LYNX PACKAGE	SNL
	•	DEMONSTRATION OF LYNX PACKAGE	
5:00	ADJOURN		

AUGUST 11, 1993

YMP OFFICE, LAS VEGAS, NV
101 CONVENTION CENTER DRIVE, SUITE 1010, ROOM 10

9:00	•	DISCUSSION OF LYNX PACKAGE AND DYNAMIC GRAPHICS PROGRAM	EG&G
	•	DEMONSTRATION OF LYNX PACKAGE AND DYNAMIC GRAPHICS PROGRAM	
11:30	LUNCH		
12:30	CONTINUATION OF ACTIVITIES AS NEEDED		
2:30	ADJOURN		

CONTACTS

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NRC:	PHILIP JUSTUS	(702) 388-6125
CNWRA:	GERRY STIREWALT	(703) 979-9129

SUPPORT

M&O:	STEVE Le ROY	(702) 794-7836
	JOHN GAUTHIER	(702) 794-1866
USGS:	RICK SPENGLER	(303) 236-1266
EG&G:	ELAINE EZRA	(702) 794-7449
SNL:	CHRIS RAUTMAN	(505) 844-4584

ENCLOSURE 1

NRC/DOE Appendix 7 Meeting

August 10, 1993 Denver, CO

3-D Modeling

NAME	ORGANIZATION	PHONE
Jim Nelson	SAIC	303-273-1271
John S. Stuckless	USGS	303-236-7889
Fair Spengler	USGS	(303) 236-1261
Ardyth Simmons	DOE/YMP	(702) 794-7998
Steve McDuffie	US NRC	301-504-3460
Clay Hunter	USGS	303 236-1123
David Wilson	EG&G EM	702-794-7581
JOHN GARTHICK	M&O	(702) 794-1866
GERRY L. STIREWALT	CNWRA	(703) 979-9129
Chris Kaufman	Sandia	(505) 844-4584
Don Chery, Jr.	US NRC	301-504-3461
David Buesch	USGS	702 794 7195
BOB Dickerson	SAIC	303 279-7242
Tracey J. Felger	SAIC/USGS	702-794-7195
Steve Le Roy	M&O/Duke Eng	702-794-7836
Ron Drake	SAIC	303 273 1206
~~BRETT GRACELY~~	~~SAIC~~	~~303~~ 279-7242
DARRELL PORTER	SAIC	505-236-0532
Daniel J. Gockel	USGS	303-236-1418
MARK C. TYNAN	DOE/YMPO	702-794-7940

ENCLOSURE 2

Management Plan for 3-D Geologic Modeling

- YMPO Program Requirements
- Technical Requirements
- Models and Input Data Sources
- Implementation Plan

ENCLOSURE 3

3-D Modeling:
YMPO Program Requirements

- **Long-Term Need for Integrated Geo-Data"Model to support :**
  - **Performance Assessment**
  - **Annotated Outline**
  - **Site Suitability**
  - **License Application.**

3-D Modeling:
YMPO Program Requirements

- **Short Term (FY'94) Need for Near-Real-Time" Views of Subsurface Conditions (based on latest available data) to Support**
  - **ESF Design Construction**
  - **Test Planning/Management**
  - **Program Planning/Work Scope Consolidation**
  - **Technical Trade-offs/Issue Resolution**

Technical Requirements

- **Integrated Model/System Must Accommodate Broad Range of Geo-Data Sources:**
  - Stratigraphy
  - Geohydrology
  - Structure/Tectonics/Volcanism
  - Geochemistry
  - Thermo-Mechanical Properties
  - Rock Quality (Fractures, Faults, Etc.) to support ESF Design
  - Surface Geology Data
  - Supplementary Data Generated by Oversight Groups
  - Geophysical Data

Technical Requirements

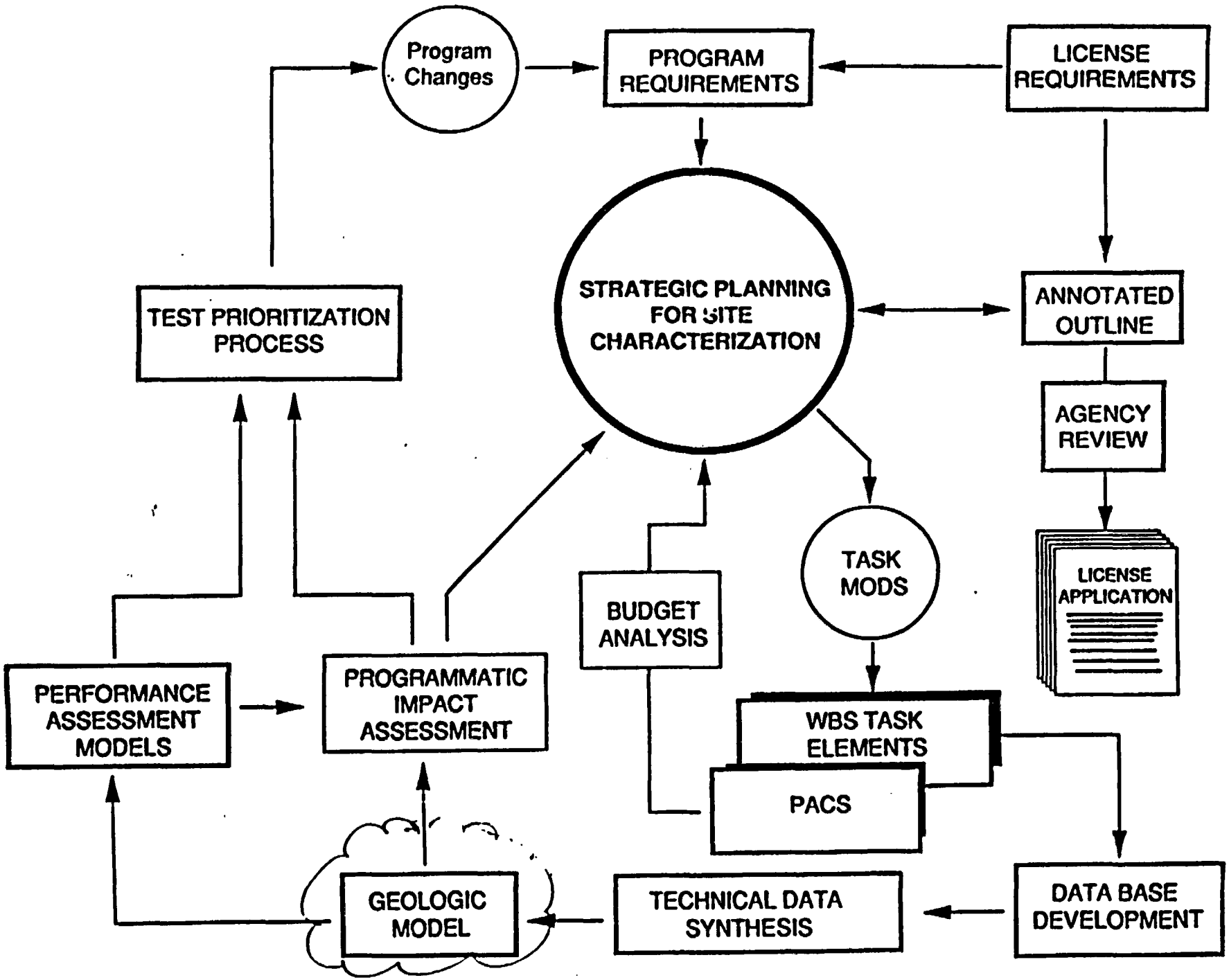
- **Model Must Correlate All Data to Common X, Y, Z Grid and Produce Visual Products for Briefings, Reports, Analysis, Etc.:**
  - **Cross Sections, Fence Diagrams, Etc.**
  - **Isopachs**
  - **Structure Contour Maps/3-D Isometrics**
  - **Volumetric Models in 3-D**

Models and Input Data Sources

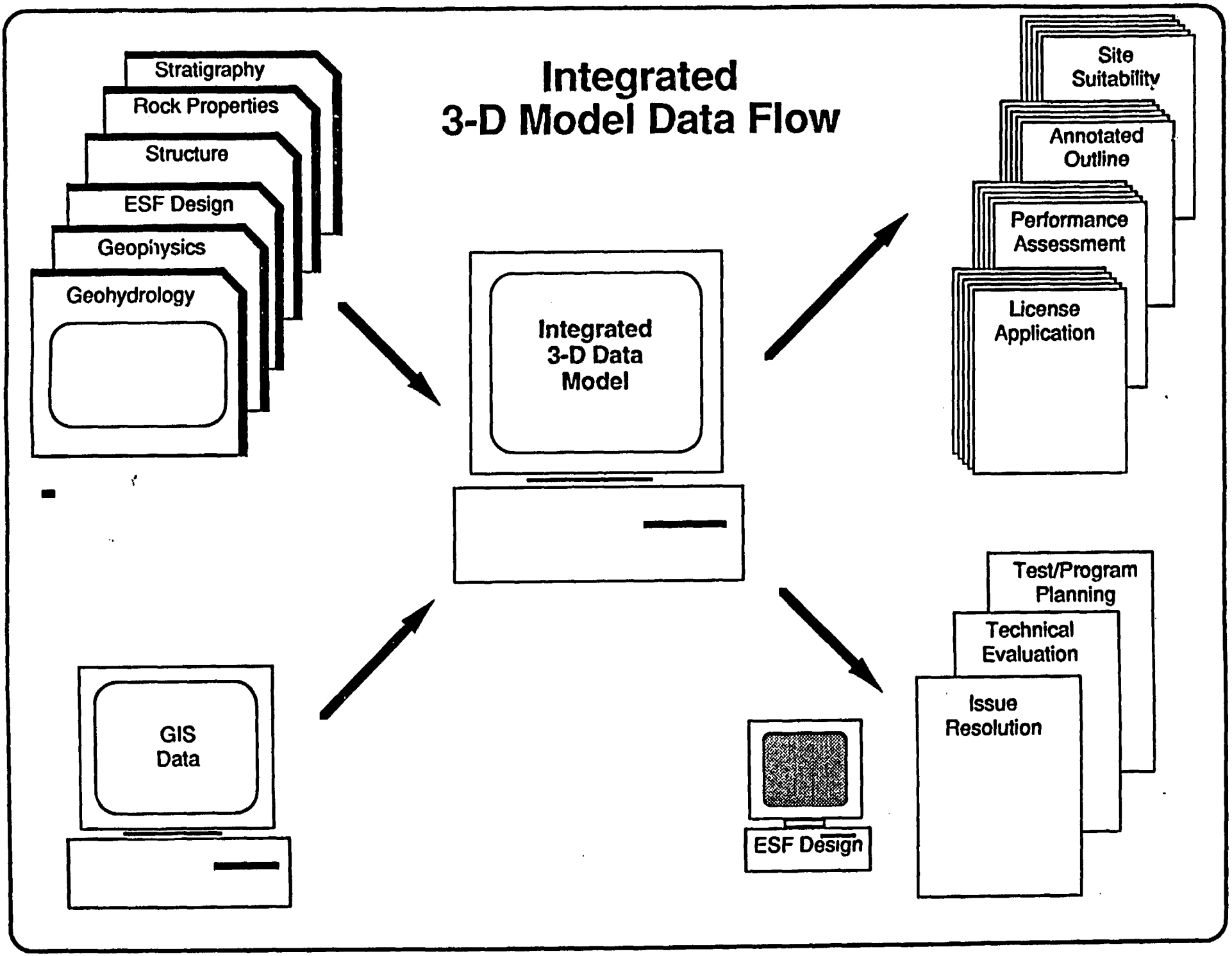
• EG&G/M&O	Synthesize Model Data, Coordinate and Develop Integrated 3-D Model, Link to Technical Data Base
• M&O	ESF Design, Integrate Geology/ Structure/Rock Properties into Design
• USGS	Rock Characteristics, Stratigraphy/ Structure Geologic Model
• SNL	Rock Characterisitics, Thermal/ Mechanical
• USGS	Hydrologic Model
• USGS/LANL	Tectonics/Volcanics
• LLNL	Geochemical Model
• LANL	Geochemical/Mineralogical Data
• LBL	Hydrologic Model

Implementation Plan

- Develop Integrated Data Model in DGI Format from Other Existing Models.
- Acquire Lynx to Accommodate Data Transfer without Developing Data Transfer Algorithm (LYNX ⟷ DGI)
- Develop Proactive Program Support Capability:
  - Hardware/Software sufficient for Real-Time Analysis and Product Development
  - Technical Support from EG&G, Data Synthesis by M&O
- Develop Rigorous Specifications for Model and Data Deliverables.
- Develop Integrated Modeling Approach among Participants, Coordinated and Directed by YMPO.



Strategic Planning Process For 1.2.3


Integrated
3-D Model Data Flow
Stratigraphy
Rock Properties
Structure
ESF Design
Geophysics
Geohydrology
Integrated
3-D Data
Model
Site
Suitability
Annotated
Outline
Performance
Assessment
License
Application
GIS
Data
ESF Design
Test/Program
Planning
Technical
Evaluation
Issue
Resolution

LYNX CHARACTERISTICS - STRENGTHS AND WEAKNESSES
Combination of both raster and vector technologies: Vector : Ability to model definable (hard) geological boundaries to appropriate level of detail. Raster : Ability to model spatially distributed variables or simple geologic settings.
Visualization : LYNX uses a 2D viewplane for interactive graphics operations, the results, however, are fully 3D (+):Engineers and geologists are more familiar with and work more efficiently in 2D, thus making the system logical and intuitive (-):Viewing of 3D is possible w/in LYNX but not timely and of a low resolution (enhanced w/ Wavefront)
IMPORT/EXPORT & INTERFACING IMPORT : ASCII EXPORT : HPGL, DXF, ASCII, Postscript INTERFACE : ARCINFO, Auto-Cad, and GENEMAP GIS
VOLUMETRICS (+):LYNX fully volumetric; provides precise volume of irregular geologic shapes, variables, and intersections with engineered features
ENGINEERING OPTION (+):Fully integrated 3D underground and surface excavation design features
GEOSTATISTICS (+):Fully integrated module of 3D geostatistics developed by I. Clark of Geostokos Ltd. and LYNX Geosystems.
INPUT/OUTPUT (+):A variety of data types can be input, i.e.: Geophysical (seismic, E/M, gravity), rock properties (porosity, permeability), hydrologic properties, etc. (+):Any screen view can be output from LYNX, i.e.: Cross Sections, Fence Sections, Isopachs, Structure-Contour Maps, etc.
GRIDDING METHODOLOGY (+): Triangulation - Maintains/preserves data accuracy and does not introduce error
GRID MANIPULATION (+):Arithmetic, logarithmic, trigonometric, and relational for both geostatistical grids and the irregular triangular grids
HARDWARE REQUIREMENTS (+):Operates on a variety of UNIX workstations : HP, IBM, SGI, and SUN

ENCLOSURE 4

LYNX CHARACTERISTICS - STRENGTHS AND WEAKNESSES

Combination of both raster and vector technologies:

Vector : Ability to model definable (hard) geological boundaries to appropriate level of detail.

- (+):Completely controlled by operator (i.e. no algorithm intermediary in the interpretative process)
- (+):Allows for an accurate depiction of structures (i.e. ability to accurately model faults and fault offsets)
- (+):Able to add higher levels of detail around areas in which the data are denser and lessen detail around areas in which the data are more sparse
- (-):Time intensive if features are complex

Raster : Ability to model spatially distributed variables or simple geologic settings.

- (+):Quick and efficient
- (-):If data are sparse or the geology complex may lead to an incorrect interpretation or editing after the feature has been created
- (-):Creation of large, cumbersome files