Space Station Operations Language, Synopsis:

The Space Station Operations Language (SSOL) will serve a large community of diverse users dealing with the integration and checkout of Space Station modules. This briefing presents KSC's comprehensive plan to achieve Level A specification of the SSOL system, encompassing both the language and its automated support environment.

The SSOL concept has been formulated to improve integration and test processing in the Space Station era. The concept is not composed of a single element, restricted to language alone, but a collection of fundamental elements that span languages, operating systems, software development, software tools and several user classes.

The following approach outlines a thorough process that combines the benefits of rapid prototyping with a coordinated requirements gathering effort. The end result will be a Level A specification of the SSOL requirements.
0 BACKGROUND: THE CURRENT KSC INTEGRATION, TEST AND LAUNCH SYSTEMS FOR SHUTTLE ARE CUSTOM SOFTWARE DESIGNS, PREDOMINATELY ASSEMBLY LANGUAGE CODING AND REFLECT AN INVESTMENT TOTALING HUNDREDS OF MAN-YEARS.

0 PROBLEM: THIS CUSTOM SYSTEM CONCEPT, COUPLED WITH DATED LAUNCH PROCESSING HARDWARE (CIRCA 1975), SEVERELY Restricts THE APPLICATION OF TECHNOLOGICAL ADVANCES THAT COULD PRODUCE A LONG TERM COST SAVINGS OR ADDDED DATA SYSTEM CAPABILITY.

In this environment, it is very difficult to use "OFF-THE-SHELF" HARDWARE (CPU'S), OPERATING SYSTEMS, DRIVERS, SHELLS, COMPILERS, AND IN SOME CASES, DEVELOPMENT TOOLS. PORTABILITY OF SYSTEM OR USER APPLICATION SOFTWARE IS RARE.
0  CHALLENGE:  TO DECREASE THE SPACE STATION INTEGRATION AND TEST
SOFTWARE LIFE-CYCLE COST WHILE PROVIDING TECHNOLOGICAL TRANSPARENCY
AND INCREASED I&T PROCESSING EFFICIENCY.  THIS WOULD INCLUDE:

- CAPITALIZING ON THE COMMONALTY OF PROCESSING NEEDS
  (AND LANGUAGES) AT THE DEVELOPMENT, INTEGRATION AND
  LAUNCH SITES.

- IDENTIFYING AND USING STANDARDS IN SSOL
  INTERFACES, SUPPORT ENVIRONMENTS, DEVELOPMENT TOOLS AND
  LAYERS.

- FACILITATING TECHNOLOGICAL TRANSPARENCY BY PROMOTING THE
  USE OF MACHINE INDEPENDENT SOFTWARE AND HARDWARE
  IMPLEMENTATIONS.

- DEFINING EARLY SOFTWARE PORTABILITY GOALS FOR:  USER
  APPLICATIONS, REAL TIME OPERATING SYSTEM S/W, LANGUAGE
  EXECUTORS AND DEVELOPMENT TOOLS
O SSOL DEFINITION: A USER ORIENTED SPACE STATION OPERATIONS LANGUAGE THAT IS:

- NEAR ENGLISH-LIKE AND SELF DOCUMENTING
- RELATIVELY TEST ARTICLE, INTERPRETER AND DATA BASE INDEPENDENT
- EXECUTABLE IN A REAL-TIME ENVIRONMENT AND CONTROLS USER INTEGRATION AND TEST PROCESSES
- AN EVOLUTION OF EARLIER, HIGH ORDER, PROCESS CONTROL LANGUAGES

O SSOL SUPPORT ENVIRONMENT: (KSC APPLICATION) THE NECESSARY ON-LINE AND OFF-LINE SOFTWARE SUPPORT ENVIRONMENT THAT FACILITATES SSOL LANGUAGE EXECUTION. INCLUDES THE OPERATING SYSTEM (NUCLEUS AND OS SUPPORT SOFTWARE), COMPILERS, EXECUTORS, CONFIGURATORS, SYSTEM-BUILD TOOLS, AND CONFIGURATION MANAGEMENT TOOLS.
NASA BENEFITS: NASA WILL BENEFIT IN SPACE STATION INTEGRATION AND TEST PRODUCTIVITY IMPROVEMENTS BY THE REASONABLE APPLICATION OF SSOL CONCEPTS. THE GOALS ARE:

- SIMPLER OPERATION AND DECREASED LIFE-CYCLE SOFTWARE COSTS
- REDUCTIONS IN THE REQUIRED DEGREE OF SPECIALIZATION IN HARDWARE, SOFTWARE, AND PEOPLE.
- BETTER LONG-TERM USE OF TECHNOLOGY, REDUCING NASA'S ONE-TIME DEVELOPMENT OR RE-HOSTING COSTS.
- GREATER REPEATABILITY OF I&T TEST ACTIVITIES BY THE USE OF TRANSPORTABLE USER APPLICATION PROGRAMS THAT FOLLOW THE TEST ARTICLE
0 RELATED R&D EFFORTS:

- JSC LEVEL C: SDE DEVELOPMENT, ON-BOARD SYSTEMS DEVELOPMENT INCLUDING THE EXECUTION OF HIGH ORDER LANGUAGES, UIL, AND I/F TO GROUND SYSTEMS

- GSFC: USER INTERFACE LANGUAGE DEVELOPMENT (UIL), STOL, TAE, PAYLOAD OPERATIONS SUPPORT

- UNIVERSITY OF COLORADO: USER INTERFACE LANGUAGE, PROCESS CONTROL TECHNIQUES.

- SSDS ARCHITECTURAL STUDY CONTRACTORS: SDE, SOFTWARE DEVELOPMENT, SYSTEM STANDARDS AND TOOLS

- VARIOUS GROUPS IN AI, EXPERT SYSTEMS, ADA AND MAN-MACHINE INTERFACES.
KSC/SSOL TECHNICAL APPROACH:

1. TO DEVELOP, DOCUMENT AND DEMONSTRATE A VIABLE SSOL LANGUAGE AND S/W SUPPORT ENVIRONMENT CONCEPT.

2. TO DEFINE A PROCESS FOR TECHNICAL INVOLVEMENT WITH KEY CENTERS, USERS AND DEVELOPERS WITHIN THE INTEGRATION AND TEST COMMUNITY.

3. TO PRODUCE A COORDINATED SSOL LEVEL A SPECIFICATION TO JSC LEVEL C.

4. TO VALIDATE AND REFINE THE CONCEPT IN A VAX-BASED R&D LABORATORY SETTING THAT FACILITATES TECHNICAL INFORMATION EXCHANGE.
THE SSOL CONCEPT FOCUSES ON:

- Portability of system and user S/W where feasible
- Optimal use of commercial S/W
- Promotion of system and development S/W standards
- Support of an interpretive execution mode
- Extensive use of data bases for: language interpretation, test article definition, off-line processes
- Inclusion of selected new technology advances in: AI, language development, tools, automation, graphics, windows and icons
0. SSOL ENVIRONMENT AND INTERFACES:

KSC TASKS:
- DEFINE USER REQUIREMENTS
- DEFINE SSOL FUNCTIONAL REQUIREMENTS
- DEFINE NON-SSOL FUNCTIONAL REQUIREMENTS
- DEFINE ON-LINE CAPABILITIES
- DEFINE OFF-LINE CAPABILITIES
Architectural Goals and Objectives

- Supporting Objectives

OVERALL GOAL
Reduce Life Cycle Cost of Integration, Test, and Operation of the Space Station

INTERFACE COMMONALITY
- Factory Element Test
- Subsystem I&T
- System I&T
- Space Station Module I&T
- Operational Support

USER FRIENDLINESS
- Easy to Learn/Use
- Requires Little or No Professional Programming Background
- Can Be Tailored to A User's Needs

PROCEDURE PORTABILITY
- SSOL Procedures Must Be Portable From One Level of Integration and Test to the Next

SYSTEM INDEPENDENCE
- Independent of Test Article
- Independent of Host/Target Computer System

MAINTAINABILITY
- Major SSOL Design Issue
- Tools for Maintenance of Large User Projects
Top Level View of SSOL SE
Overview of On-line SSOL SE

- Overall Organization:
  An Integrated Set of Application Programs

- Major Components and Relationships:
Overview of Off-line SSOL SE

SSOL SE Functions
- SSOL Procedure Production
- SSOL Display Production
- On-line Configuration Specification
- Test/Control Article Specification
- Test/Control Article Interface Specification
- On-line SSOL SE Configuration Production
- Operational Release Support
- Help Software

Configuration Management
- Tool Set *

Configuration Management Data Base *

Planning and Scheduling
- Tool Set *

SSOL SE Products
- Procedures
- Displays
- On-line SSOL SE Configuration DB
- Test/Control Article DB
- Test/Control Article Interface DB
- Operational Release

*Tool Sets and Data Base Provided by SDE
THE SSOL DEFINITION PROCESS:
Documentation and End Products (KSC)

- SSOL Technical and Project Control Documentation

  **Planning Documentation**
  - POP Inputs
  - KSC SSOL Plan
  - Tri-Center Planning Package

  **Requirements and Conceptual Design Documentation**
  - SSOL Requirements for I&T Community
  - Integrated SSOL Requirements
  - Assessments and Trades Report
  - SSOL Level A Specification

  **SSOL Concept Evaluation Documentation and Products**
  - Rapid Prototype Demonstrations
  - Concept Evaluation Reports (2)

  **Internal KSC Documentation**
  - Working Papers
  - Prototype Design Documentation
  - Demonstration Scenarios
  - T&E Reports
  - Periodic Change Recommendations
KSC Approach

- Provides Concrete Evaluation, Validation, and Refinement of SSOL Requirements/Concepts

- Initial KSC Focus on Needs of I&T Community
SSOL DEVELOPMENT LABORATORY:

- VAX 11/780 BASED
- TWENTY-TWO MEMBER TEAM. JOINT CIVIL SERVICE AND CONTRACTOR.
- EMPLOYS RAPID PROTOTYPING: REQUIREMENTS-PROTOTYPE-DEMONSTRATE-UPDATE LOOP
- SOFTWARE INCLUDES:

  OPERATING SYSTEM (DEC VMS)
  DATA BASE (DATATRIEVE)
  LANGUAGE DEVELOPMENT S/W (TWS)
  GRAPHICS DEVELOPMENT S/W (PRECISION VISUALS AND DEC)
  MODELING SOFTWARE (ASPEEN)
  EMULATION SOFTWARE (POLYGON-240)
  UNIX
  PASCAL
  ADA
ACCOMPLISHMENTS:

- Concept development and requirement teams established
- KSC user team established
- SSOL development laboratory established
- Documentation underway: (not a complete list)

DOCUMENT:

KSC SSOL REQMTS. AND CONCEPT EVAL. PLAN COMPLETE
TRI-CENTER PLAN IN REVIEW
SSOL CONCEPT DOCUMENT DRAFTED
SSOL SYSTEM REQUIREMENTS IN WORK
SSOL PROTOTYPE DEFINITION DOCUMENT IN REVIEW
## Schedule

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### SSOL REQUIREMENTS AND CONCEPTUAL DESIGN DEFINITION

- [ ] Tri-Center Planning
- [ ] I&T Requirements and Concept Definition
- [ ] Integrated Requirements and Concept Definition
- [ ] Assessments and Trades
- ▲ Level A Specification Preparation

### CONCEPT EVALUATION

- [ ] Demonstration Laboratory Activation
- [ ] Existing System Demonstration and Evaluation
- [ ] SSOL Prototype Definition and Implementation
- [ ] SSOL Prototype Demonstration
- [ ] Performance Test and Analysis
- ▲ Periodic Concept Review and Assessments
- ▲ Concept Evaluation Reports

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