CRITICAL PEER REVIEW

of the

PROGRAM ARCHITECTURE SUPPORT SYSTEM (PASS)

Being Developed by the

SwRI Center for Nuclear Waste Regulatory Analyses (CNWRA)

on behalf of the

Nuclear Regulatory Commission

Report Prepared for the CNWRA

by Charles L. Acree, Jr., independent consultant

San Antonio, Texas

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I. BACKGROUND

The Center for Nuclear Waste Regulatory Analyses (CNWRA), within the Southwest Research Institute (SwRI), was established in October 1987, when it was awarded a five-year contract with the U.S. Nuclear Regulatory Commission (NRC). Operating as a Federally Funded Research and Development Center (FFRDC), the CNWRA will provide technical assistance and research to help the NRC meet requirements of the Nuclear Waste Policy Act of 1982 (as amended by Congress in 1987). The Act sets forth a procedure and schedule for construction of the nation's first repository for the secure disposal of high-level nuclear waste (HLW) - material which will remain radioactive for hundreds of years.

The NRC is responsible for licensing the repository, which will be built by the Department of Energy (DOE). According to schedule (presuming there is no delay), the DOE will submit a formal application in 1994 for repository construction at Yucca Mountain, Nevada. Upon receipt of that application, the NRC will have just three years to approve or disapprove it - a tight deadline in view of the numerous legal and technical ramifications involved. If approval is granted by the NRC, construction will proceed and the repository should be ready to receive HLW in 2002. Further NRC licensing actions will be required then and in succeeding years to permit gradually increasing quantities of material to be transported to the site and stored there, followed by actions permitting the repository to be decommissioned and monitored.

A more immediate deadline looms in January 1989, when the DOE is expected to submit a Site Characterization Plan (SCP) to the NRC for review.

The CNWRA is currently developing a "Program Architecture" (PA) to provide a systems-engineering and integration framework for the complex licensing process, which will commence, in effect, with the SCP submission. The PA calls for identification of pertinent regulatory requirements, establishment of methods of compliance determination, and painstaking formulation of related information needs, uncertainties, and priorities. This preparatory work will help the NRC negotiate streamlined procedural rules with the DOE and intervenors to manage submission of the millions of documents that the licensing process will generate.

It has been clear to those involved in PA planning that a computer information system will be essential to support the intensive research activity that is foreseen, to store and retrieve the voluminous information involved, to display the PA in a logical and understandable manner, and to facilitate timely responses and recommendations to the NRC.

The CNWRA has therefore initiated the development of a computer-based "Program Architecture Support System" (PASS).

Following the submission of two preliminary reports to the NRC on PASS and the demonstration of a viable prototype, the CNWRA President asked the author to conduct a critical peer review of the system to provide an independent evaluation of its prospects to meet near and long-term goals.

II. REVIEW PROCEDURE

The author:

1) Held initial exploratory conversations with the CNWRA President, Technical Director, and Director of Information Management Systems (IMS) to establish review procedure.

2) Studied CNWRA background materials and the available documentation on PASS, provided by the Director/IMS, which consisted primarily of two reports:

- WSE&I Major Milestone No. 18 Interim Report on the Development of a Program Architecture, April 1988
- ADP Plan for the CNWRA, May 24, 1988

(PASS specifications are incomplete because development was begun only 3-4 months ago, in early March. The IMS staff has concentrated its efforts on the rapid development of a useful, demonstrable prototype.)

3) Formulated questions for discussions with CNWRA managers.

4) Held several discussions with the Director/IMS, who bears responsibility for the planning and implementation of PASS.

5) Evaluated existing PASS-prototype capabilities on a computer terminal.

6) Interviewed the CNWRA President, Technical Director, and Director of Systems Engineering and Integration - to understand the essential requirements that PASS must meet to satisfy major milestone needs (validating assumptions made by the Director/IMS) and to set bounds for this report.

7) Interviewed the Director of the SwRI's Central Computer Facility (CCF) and his superior, the SwRI Financial Vice President, to evaluate present and future capabilities of the CCF to support PASS development and maintenance.

8) Interviewed the CNWRA Director of Quality Assurance, the CNWRA Director of Administration, the Director of the CNWRA's Washington office, a CNWRA manager who contributed heavily to the building of the PASS prototype, and the two independent contractors who have been closely associated with the prototype development.

9) Expressed concerns and offered suggestions all the while to CNWRA management, in an effort to assist the evolving PASS design process.

10) Submitted the initial version of this report to the CNWRA President within three weeks, as requested, as a product that had been examined in draft form by CNWRA management.

III. FUNCTIONAL DESCRIPTION OF THE PASS SYSTEM

The following description summarizes information contained in available PASS documentation, amplified by discussions mentioned above.

PURPOSE:

PASS is intended to support the NRC's HLW repository licensing review process, through the framework of the CNWRA-developed Program Architecture.

ADMINISTRATION:

During the first two years of the CNWRA contract with the NRC, PASS will be administered and used primarily by the CNWRA staff. Afterwards (after September 1989), PASS and the Program Architecture itself will be administered officially by the NRC (though PASS will remain physically at the CNWRA). Meanwhile, the NRC will exercise oversight and have ready access to PASS through a leased line that will link the CNWRA in San Antonio, Texas, with NRC headquarters near Washington, D.C.

COMPONENTS:

1) Office-automation capability for word processing, personal calendars, and the transmission and storage of electronic mail between the CNWRA and the NRC.

2) Management-information capability to summarize CNWRA expenditures of financial and human resources, with tables and graphs, in periodic, printed report form and in response to on-line queries, incorporating cost-impact, decision-support methodology.

3) Activity-tracking capability to assess CNWRA progress in completing its scheduled tasks, through periodic reports and on-line project-status queries.

4) Information-retrieval capability, through maintenance of relational data pertaining to the PA and storage of various regulations and documents relevant to the licensing process - for on-line, full-text descriptor/keyword search and subsequent display on the computer terminal or in print.

5) System-connection capability, permitting CNWRA and NRC access to related on-line information systems, as they become available, including the DOE-initiated Licensing Support System (LSS) and the NRC's Work Plan System.

ANTICIPATED BENEFITS:

PASS will facilitate the CNWRA's, and eventually the NRC's, daily work by providing essential office automation and financial/managerial support - including a standardized, formal reporting process. Aside from these routine benefits, PASS will provide rapid, common access to requisite legal and technical information, organized in a way that will highlight issues requiring resolution and essential work to be accomplished on schedule.

The CNWRA was just established last year. The licensing of a HLW repository is a completely new process. There is no "old system" or "manual system" to be replaced by PASS or to be compared with it.

It is costing nuclear power plants hundreds of millions of dollars annually to maintain spent fuel (HLW) safely on their premises, which could be stored far more economically within a permanent repository. Any tools that can help the NRC streamline the licensing process, forestall anticipated difficulties through negotiated rule-making, and reduce the risk of missing critical deadlines can therefore be readily justified financially. The cost of enlisting a supportive computer system such as PASS is considered relatively insignificant in this context.

TIMETABLE:

The NRC will begin using PASS electronic-mail and program scheduling capabilities in July.

An upgraded PASS prototype will be made accessible, in all of its available functions, to the NRC in October 1988.

PASS will be further developed and loaded with regulatory (PA) information by December 1988, so that it may be used to identify opportunities for negotiated rule-making and substantially assist SCP review during 1989.

PASS will be fully developed by September 1989, when the PA will be complete and the entire system will become a deliverable to the NRC. Requirements for this time frame and beyond are being refined.

Following delivery, PASS will incorporate an increasing store of information relevant to the licensing process.

The system is expected to operate for many years - through the entire NRC licensing process and possibly until the HLW repository is decommissioned during the latter half of the 21st century.

DETERMINATION OF REQUIREMENTS:

Because the CNWRA staff is currently small and coherent, PASS requirements in support of the PA have been framed in a straightforward fashion by CNWRA managers, with NRC concurrence. No user surveys have been undertaken.

USERS:

Users may number as many as 83 by the end of the fifth year of the contract, by which time the CNWRA will have reached maximum employment (68) and the NRC should be using the system extensively. Direct access by other organizations is not planned, aside from CNWRA subcontractors in Minnesota and Colorado. Concurrent (simultaneous) system users may number 40-50 during peak hours. PASS will, for the most part, be directly queried by interested technicians, licensing specialists, and managers, rather than by intermediary information-system specialists.

QUERYING THE SYSTEM:

PASS will be used by different people (engineers, lawyers, administrators) for different purposes. Nearly everyone will use word processing and electronic mail. A few will focus on financial data. Many will use the scheduling and information retrieval capabilities.

It is anticipated that most everyone will be accustomed to using computer-based systems, thereby obviating the need for lengthy training, a comprehensive user manual, or a keyword thesaurus - unless the system becomes more complicated and extensive.

Document queries will be made with straightforward Boolean terminology (employing keywords connected by AND, OR, NOT), enriched by word-stem truncation and proximity search, as desired. The entire system will be menu-driven, contain term descriptions, make use of "help" functions, and prompt the user with regard to expected commands.

Hardcopy, as needed, will be provided by means of nearby printers and plotters.

No priority access scheme, to allow user precedence of any kind, is contemplated. Nor will there be built-in frills, such as misspelling tolerance or provision for document annotations.

All the above considerations will apply to NRC, as well as CNWRA, use.

DATA BASE LOAD AND MAINTENANCE:

Users will directly input word processing, electronic mail, financial data and scheduling plans - on-line, on a continuing basis, during the normal course of their everyday work, subject to procedures set by the CNWRA.

Full-text document entry into the system, which must be indexed with relational indicators, will be a more complex process. The document store (at least initially) will be completely centralized, not dispersed. This input will generally be accomplished off-line, during routine maintenance periods, using tapes or disks whenever they are available to avoid as much keying as possible. Indexing will be performed automatically by PASS, which will create and repeatedly update a list of meaningful terms it finds in the documents to enable "full-text" retrieval of the documents in which they are contained. Later, depending on the extent and quality of documents to be loaded, optical character recognition and scanning techniques may be added.

During the first two years of the contract, the PA will be constructed by CNWRA staff members themselves, using PASS on-line. For this purpose, all applicable statutes, regulations, standards, and guidelines will be loaded into PASS full-text from tape for convenient reference. CNWRA staff will then originate a "Relational Data Base," by parsing these lengthy documents into specific requirements and linking them analytically to prioritized elements of proof, perceived uncertainties, and intended methods of reducing the various uncertainties.

In addition, a sizable technical document file will be abstracted and indexed for entry into PASS, with regulatory references wherever possible. Documents that have been sent and received via electronic mail between the CNWRA and the NRC will also be indexed with relational indicators.

PASS will have only a rudimentary capability for the storage of limited-access documents. Any privileged holdings that use system facilities cannot be considered inviolate.

SYSTEM SECURITY:

The common store of documents will be protected by routine password authorization. This will provide a basic measure of access control for privacy and data integrity.

In early June, the CNWRA received notice from the NRC that it anticipates that data stored and processed by PASS, though it is unclassified, will be considered sensitive - requiring a security plan with stringent safeguards that would significantly affect plans for PASS development and maintenance. This will be discussed below.

IV. PASS SYSTEM IMPLEMENTATION

PASS is being developed in stages, from a prototype model. Therefore, five stages of PASS implementation will be discussed: the existing prototype, the October upgrade, the completion of the basic system by December, the implementation of the full system in September 1989, and the plans for follow-on development.

THE EXISTING PROTOTYPE

With limited staff (one employee aside from himself), the Director/IMS has used IBM assistance and two independent contractors to implement the prototype, employing standard IBM software packages on a shared IBM computer located within the general-purpose SwRI Central Computer Facility (CCF).

The CCF (which serves SwRI as a whole, in most everything but application programming, and bills for it through a standard charge-back scheme) helped the CNWRA by setting up terminal access to the computer through its local area network. It also upgraded its 4300-series computer ahead of schedule to meet near-term CNWRA requirements.

This arrangement was not merely convenient. It will provide desired compatibility with the NRC's IBM computers. The SwRI Facility's computer was upgraded to an IBM 4381-3, with 24 million bytes of main memory. (A DEC VAX-8700 is also available to CNWRA technicians through the local area network.)

The IBM commercial software packages, running under the VM operating system, include: PROFS for general office automation (word processing, electronic mail), DW370 for report formatting, AS for resource analysis and project scheduling, SQL/QMF for formatted (relational) file queries, and CF-SEARCH for text search by keywords (which are indexed automatically by CF-SEARCH when the documents are entered into PASS). All these packages come with standard reference manuals for system users.

In PASS, the SQL/QMF facility to query a formatted file is called the "Relational Data Base". The existing records contain several searchable fields, including regulation sub-sections, regulatory requirements, cross references, cognizant organizations, knowledgeable experts, "issues", and required "findings". There are other fields available but not fully utilized yet, including uncertainties, action agencies, and dates of required action. SQL/QMF employs relational tables that link records to one another on the basis of their content (currently, on the basis of "findings" and "issues").

The SQL/QMF packages also contain the ability to "query by example", a capability that has not been used thus far but may be adopted in the future.

A (sufficiently fast) 9600-baud line has been leased to connect the NRC with the SwRI Central Computer Facility to permit a few people at the NRC, as well as the CNWRA's Washington office, to exchange electronic mail using PASS and to access the scheduling component.

The PASS data base currently contains just one financial breakdown (for Task 1.1 for Waste System Engineering & Integration), two sets of project management schedules (CNWRA and NWPA), about 2,400 regulatory requirements derived from a dozen CFR's and other key regulations, with matching "findings", and 12 dummy "issues" (input for the demonstration) - all related to one another through the tables.

The existing Relational Data Base (regulatory requirements, "findings", "issues", and related fields of information) was prepared for entry into PASS in March and April by eight CNWRA staff professionals and about ten knowledgeable SwRI engineers. Half of the people worked full time on this effort. Actual data entry was then accomplished by a dozen or so clerks, who keyed in the information contained on two-page input forms that the experts had completed. Relevant regulations had been identified mainly by the CNWRA's Washington office, working closely with the NRC. Due to the rush, lack of mutually-agreed-upon instructions for completing the forms, and misunderstandings, there was some inconsistency of input (in the "findings" statements, for example).

UPGRADE OF THE PROTOTYPE IN OCTOBER 1988

Generally speaking, two things must happen by October. PASS software will be upgraded and further data entry will take place.

The software upgrade will include an improvement of the inter-relationship among the commercial software packages, new and enhanced software maintenance capability in all

areas, an ability to generate required reports to the NRC, improved scheduling capability, a re-definition of the fields in the relational data base, an ability to permit professionals to enter data on line rather than on input sheets, and the ability to load an electronic mail and technical document index.

Data entry (for the Relational Data Base) will focus exclusively on "site-constrained" regulatory requirements, giving priority to those that are considered time-critical. This might reduce the number of regulations by 50% or more, though estimates vary widely. Field names will be changed in accordance with new terminology that has been worked out recently with the NRC. Data relating to regulations that are not site-constrained will be removed from the existing data base (and held separately), while more use is made of available data fields with respect to applicable regulations.

The data entry process, this time, will be accomplished on-line, without clerks, employing the augmented SWRA staff and the same essential group of part-time SwRI associates. It is considered that minimal training will be required for on-line entry, provided that clear guidelines help everyone to do it right. The element-of-proof and uncertainty-reduction-method entries, for example, might be categorized through number codes to facilitate consistent entry, if this will not force unique entries into unwarranted uniformity.

The guidelines for data entry, involving all of the above considerations, will be set by the CNWRA Program Architecture Review Committee (PARC), yet to be formed, which will review all entries to assure quality control. The precise procedure for PARC review and the specific composition of the PARC are currently being established.

The applicable regulations themselves will be loaded into PASS in full text, from tapes that the NRC will provide.

The technical document index to be loaded in October will include references to a bookcase plus a few boxes of printed material in the CNWRA office and to 50 linear feet of material expected to be received from the NRC by that time.

To augment his capability, the Director/IMS intends to add a data-base administrator and at least one additional analyst/programmer to his staff by October, and also to recommend the employment of a scheduling expert to help the CNWRA handle this complex activity with PASS.

The NRC will gain full access to PASS in October, on a read-only basis insofar as the PA is concerned. A few more people there will use it. CNWRA intends to train the NRC

in the use of the system at this time (by training a trainer, with on-line demonstrations).

IMPLEMENTATION OF THE BASIC SYSTEM IN DECEMBER 1988

The data entry process will extend through December. By that time, all of the site-constrained regulations will have been identified and PASS is expected to be loaded with all site-constrained regulatory requirements, elements of proof, regulatory and institutional uncertainties, and uncertainty reduction methods - as appropriately evaluated and prioritized by CNWRA staff.

PASS may have to handle as many as 20 concurrent users by then - in San Antonio and Washington.

Even if the PASS Relational Data Base is "80% loaded," as anticipated, by this time, PASS should still be easily contained on just one of the IBM-3380 disk drives at the SwRI Central Computer Facility. (One of these newer drives can hold 2,520 megabytes.) File space will not yet be a concern.

No specific software modifications are scheduled for the two-month October-December period. But enhancements will continually be made and a few of the non-essential improvements intended for October may spill over into this timeframe.

IMPLEMENTATION OF THE FULL SYSTEM IN SEPTEMBER 1989

After December 1988, it is intended that PASS will become a truly viable system, not merely a demonstrable, experimental prototype. Good use of it will be made to create a full-blown Program Architecture during 1989, so that the entire product may be presented to the NRC in September, in compliance with the contract.

Any advisable changes in commercial software packages (such as AS or CF-SEARCH) will be implemented during this period. Steps will be taken to comply with whatever security requirements are finally imposed by the NRC. Though system recovery has not yet been a substantial problem, the SwRI's Central Computer Facility intends to acquire an Uninterruptable Power Supply, which will help ensure PASS availability in the event of temporary power failures. Thought will be given to backup of the data base more than once a week, which is currently the case.

Procedurely, it will be necessary to initiate a controlled, authoritative, CNWRA/NRC process to modify the data that has already been entered into PASS, if it is subsequently considered unnecessary or mistaken for one reason or another, unless the PARC is empowered to do this without consulting the NRC.

PLANS FOR FOLLOW-ON DEVELOPMENT

It is currently envisioned that the SwRI Central Computer Facility (CCF) will meet the needs of PASS during the three remaining years of the initial contract, and that PASS will continue to rely on much the same mix of IBM software products, which are likely to be upgraded by IBM to provide improved capabilities.

However, consideration will be given to the purchase of a dedicated computer, apart from the CCF. Alternative software packages will be examined during the latter half of 1988, with an eye to future growth of PASS (including the desirability of taking better advantage of the CCF's under-utilized VAX computer, which is currently being considered only for scientific modeling).

If plans do not change with regard to hardware, a larger (IBM-3090/120E) computer mainframe is projected to replace the IBM-4381 medium-sized computer at the CCF, bringing more disk space, terminals, and associated peripheral equipment, in late 1990. There is available space for the larger computer, but remodeling will be required (for air conditioning, water-cooling, and raised flooring). The Director/IMS estimates that PASS will require about 2,700 megabytes of storage space by the year 1992, finally filling the currently-allotted IBM-3380 disk drive.

If it becomes clear that PASS is growing into a very large data base, a decision will have to be made whether to employ more sophisticated hardware (including optical disk storage technology and optical-character-recognition equipment), as well as more powerful software.

The biggest question mark with respect to this time period is the future relationship of PASS to other data bases that are being created to serve the same basic function - support of the HLW repository licensing process. It is understood that a NRC component is proceeding with a system of its own. A huge effort called the Licensing Support System (LSS) has been planned since 1979. If the LSS is developed, at a cost that could approximate $100 million, it might succeed in its intention: to serve the needs of all parties involved in repository licensing during the 1990's and beyond, and to become the sole basis for document discovery during legal proceedings.

V. AN EVALUATION OF PASS

The five stages of PASS implementation discussed above will again be considered individually: the existing prototype, the prospects for meeting the October-1988, December-1988 and September-1989 milestones, and the outlook for follow-on development.

THE EXISTING PROTOTYPE

The PASS prototype, created in March and April 1988, demonstrated that the CNWRA was able to develop a useful computer tool quickly and inexpensively to support its conceived Program Architecture. The CNWRA convinced the NRC that it could not merely plan a complex information system; it could actually produce one.

The prototype is not only successful, it is remarkable, considering the short time spent in its development and the paucity of resources available to the Director/IMS.

Prototyping is an excellent way to achieve useful systems. Many computer systems never leave the drawing boards because far too much energy is spent planning, when greater insights might have been gained through the construction of a working experimental model.

Having only a two-member staff, including himself, the Director/IMS accomplished this feat on a "can do" basis with the able assistance of a three-member IBM programming team, which consolidated the several IBM commercial software packages that constitute the prototype. The best possible advantage was taken of the services of the SwRI Central Computer Facility - obtaining the part-time programming help of one of its consultants in the bargain.

The IBM team pieced together some of their company's most complex software packages so that they could relate to one another usefully as a coherent whole. They did so, however, in a necessarily make-shift, expeditious manner. A more efficient software integration scheme is possible, with the help of an additional IBM software tool that has since become available.

Unable to avail himself further of IBM assistance, the Director/IMS has recently employed a programming consultant to improve system integration (by traversing software packages and relational tables more expeditiously), as well as to develop further capability. It is commendable that the consultant is striving to develop PASS as free as possible from idiosyncrasies of the software packages, keeping his programming as simple, flexible, well-documented, and "transportable" as possible for the "migrations" that will most certainly occur in the future.

While the prototype is in need of improvement, it meets its tasks adequately. It is fairly easy to use with minimal training. Its driving menus (option lists) are relatively straightforward and its reasonably simple IBM command/query language remains essentially consistent throughout. Built-in "help" functions are usually available to tell the user (if he is patient) how to escape from difficult circumstances or how to "page" backwards to the display he left a moment ago.

On the other hand, it is not always clear where one stands in using the prototype at the terminal. It is sometimes difficult to back-track easily - imparting the impression of being "hung up." Function-key commands are sometimes suggested that are not actually available for use at that juncture. Every once in awhile it is unclear whether it is the system's or the user's turn to do something.

A few of the deficiencies can and will be corrected within the next few months. Others, unfortunately, are built into the commercial packages that have been employed. It would not be worthwhile to correct them through "custom" coding - at the cost of scarce programming resources, significant delay, and future conversion difficulties. IBM itself will gradually improve these and successor products over time. Any modifications accomplished by the Director/IMS might then have to be re-programmed, draining further resources. There has been a wise effort during development, on everyone's part, to avoid custom programming insofar as possible, in order to foster the smoothest possible evolution of the system in the years to come.

The current software packages appear to be sufficiently flexible to meet foreseen requirements through 1989.

Alternatively, the PA might have been built manually, without PASS. If computers were unavailable, this vital analytical spadework would somehow be accomplished without them. But the computer-based system being undertaken should significantly speed PA construction and, equally important, provide a logically-structured methodology. The rigors of inputting complex, inter-related concepts such as these into a computer can help clarify abstract thought, provide new insights, and bring licensing concerns to the forefront that might otherwise remain obscure.

The viability of the particular analytical approach that the CNWRA has chosen to build the PA, using PASS, can be appraised only in practice - as the Relational Data Base is structured and loaded during the coming year. The fact that this approach was entirely self-generated, however, to fit the CNWRA's own management style, bestows an important advantage that should lower the risk involved.

PROSPECTS FOR MEETING THE OCTOBER 1988 MILESTONE

There should be no problem meeting the October deadline insofar as prototype software capability is concerned. Barring unforeseen difficulties, PASS organizational structure will be complete - its Relational-Data-Base fields set, at least for the time being. PASS will gain the capability to generate required reports in the desired formats. It will also be streamlined, ready for file maintenance activity, and available for on-line input. The NRC, which will by that time have been connected to PASS for three months, making good use of its electronic mail and scheduling capabilities, will be able in October to access the regulatory (PA) file.

The potential difficulty in meeting this milestone does not lie in the area of PASS software development, but in the loading of requisite data, properly identified and reviewed by PARC, into the Relational Data Base. The PARC must review the data that is already there, determine its applicability to site characterization, modify it in accordance with the new terminology if it is to remain in the data base, and establish a quality-controlled procedure for the expeditious on-line loading of a significant amount of additional conceptual data. This will be very time-consuming.

The idea of creating number codes for elements-of-proof and uncertainty-reduction-methods seems a good one, but will require careful quality control if it is employed.

It is extremely important that the Director/IMS be fully involved with the PARC, from the outset, in the creation of data entry procedures, to assure their feasibility.

The plan to load a large techical document index, with references to related regulations, and to store the CNWRA-NRC electronic mail with similar references will contribute further toward a formidable data entry workload for CNWRA as a whole during the summer months. Here, too, thorough procedural preparation is a must.

The office-automation, management-information and activity-tracking aspects of PASS do not appear to present any unusual software problems in October or in later stages of PASS, though considerable time will be spent improving and inter-relating those capabilities.

It would be helpful to the Director/IMS if his authorities were more clearly defined so that he could proceed to explore certain initiatives (such as linking the PASS accounting system to the SwRI accounting system) and if the ADP budget could somehow be put more directly under his control, so that he could plan more effectively.

PROSPECTS FOR MEETING THE DECEMBER 1988 MILESTONE

Until mid-June, it was unclear what, specifically, must be ready, without fail, by December 1988 with respect to PASS. That flexibility no longer exists, given the NRC's recent mandate that site-constrained regulations, requirements, elements of proof, regulatory/institutional uncertainties, and their reduction methods must be loaded into the PASS Relational Data Base by then.

Here, too, potential difficulties should not arise in the area of PASS software availability, but rather in the data entry area, which will consume a sizable amount of expert labor. Presuming that the organizational structure is worked out and the conceptual work can be accomplished by CNWRA staff under a significantly accelerated deadline, it would appear that everyone will have to work extremely hard to get all of the requisite Relational-Data-Base information loaded into PASS via on-line terminals before early December.

An agreed-upon procedure for modifying or removing mistaken or unnecessary PASS entries, on a continuing basis, might also be needed as early as December.

There is no point in pursuing any significant changes in PASS software before December. It would seem proper to consider the software still experimental during the remainder of 1988. It should be able to handle the job adequately. Indeed, it would be foolhardy, under existing circumstances - with such a small staff, to attempt to modify software in any radical way before a deadline only a few months away. One should always plan ahead, however.

Sometime before December, PASS specifications should be more thoroughly documented. (It is now planned to complete them by early August.) Total flexibility in a prototyping mode is fine up to a point, but a system nearing a firm completion date requires a certain measure of solidity in order to progress. More detailed written requirements will permit the SwRI's CCF to provide an optimum level of support. Some hard planning will be needed during the coming year regarding the intended future of the system.

Obviously, the Director/IMS must succeed in augmenting his permanent staff, as he envisions, to conduct the essential planning, procedural and documentation work that needs to be accomplished and to provide reliable, continuing expertise to develop and maintain PASS.

PROSPECTS FOR MEETING THE SEPTEMBER 1989 MILESTONE

At this point, specific requirements for the 1989 deadline (and beyond) do not exist. Certainly, it can be said in general terms that the completed system, supporting the Program Architecture in its entirety, is deliverable at that time. But because the PA is an evolving, developing process itself, without precedent, and because a large computerized system has never before been used in the licensing process, it is perfectly understandable that a full explication of the PASS deliverable remains to be accomplished.

During the months before PASS is formally delivered to the NRC, the CNWRA should continue to work very closely with the NRC to be certain that the best possible joint, integrated use of the system will be made subsequent to delivery.

The existing and contemplated PASS software can be expected to handle whatever is loaded into PASS by September 1989. But that is not to say that PASS software should necessarily remain the same. While it was inadvisable to modify the software significantly before December 1988, the 1989 milestone presents an opportunity to appraise more capable commercial packages that might overcome some deficiencies of the packages currently being used, be better able to handle extra-large data bases, and afford increased flexibility for future modification. It would be wise to take full advantage of that opportunity. An eye should be kept also on commercial hardware developments, such as those in the optical-disk, optical-character-recognition, and full-text-scanning areas, as requirements emerge.

There are many advantages in the continued use of IBM hardware and software products. More than most companies, IBM makes it a practice to assure compatibility from one version of its software to the next, improved release. If the CNWRA can avoid custom programming insofar as possible, accepting inevitable application-specific limitations of these generalized packages, and keep the code it writes as straight-forward, well-documented, flexible and therefore transportable as possible, it should be able to progress fairly comfortably using IBM's own upgrades.

But there is other software on the market that is both worthwhile and IBM-compatible. It, too, should be investigated for possible incorporation during this time frame.

PASS will face a very troublesome problem before it is delivered. A security plan must be developed by that time, and preferably earlier. The NRC says it anticipates that the data to be stored and processed in PASS, though

unclassified, will be considered sensitive and therefore in need of special protection. Stipulated measures include encrypted telecommunications links, audit trails of system use, locked data storage cabinets, totally secure computer operations, and a ban on the use of personally-owned microcomputers, among other things, so that PASS may be certified and accredited.

The most restrictive clause in the NRC systems security document stipulates that a sensitive system may be connected to nonsensitive systems only if measures are taken to ensure that no sensitive data can be "spilled" into the other systems. There is no way to create such assurance - anywhere, in any system, much less at the SwRI's CCF, which is linked to several outside networks that, through connections of their own, may well extend worldwide, for the convenience of any number of hackers who might seek to access or even disrupt PASS, purposely or just for fun. The NRC is understood to be more concerned about data integrity than about unauthorized access.

The Director/CCF has already said that he cannot comply with that stipulation in particular. If the rules are not softened by the NRC, the only solution is a dedicated PASS computer, purchased by the SwRI from contract overhead funds. While a dedicated computer would provide additional administrative advantages, it would also raise the need to replace services the CCF now provides, at increased cost.

There is another security issue that is not addressed by the NRC. It goes without saying that PASS, as an unclassified/sensitive system, cannot store any classified documents. However, it may become desirable, on someone's part, to originate limited-access documents during the licensing process (containing draft positions, perhaps). Such documents should not be stored in PASS, even on a dedicated computer, if true privacy (from other PASS users) is absolutely essential. They should be written only on personal computers (if computers are used at all) and stored on diskettes that can be locked safely away by the persons requiring privacy. Presuming that all such documents will be only temporarily withheld, in view of the fact that licensing is a publicly accountable process, the documents can always be loaded into PASS later, as legally appropriate.

OUTLOOK FOR FOLLOW-ON DEVELOPMENT

The most troublesome issue for PASS in the long run is whether or not it will become a very large data base - storing millions of documents relating to the licensing process. As noted above, another computer system is being designed, under a DOE contract, to do that - the Licensing Support System (LSS). After it becomes operational in the 1990's, the LSS may eventually store as many as 40 million pages (roughly equivalent to shelf space in the SwRI library). The NRC has been moving ahead with similar systems of its own.

Significant duplication of effort in this realm should be avoided. Duplication not only has a huge potential for wasting resources, it can cause tremendous confusion. If there are several data bases on the same subject, for example, which should be considered the legally reliable one? Someone will have to be placed in charge of the records management of these millions of documents. That will be a very serious responsibility indeed.

Sometime soon, these systems should be orchestrated, under NRC auspices, into a sensible, well-documented framework, so that the limited, provisional, or data-building nature of each is clear to everyone concerned. The CNWRA would greatly benefit from specific policy guidance on this matter from the NRC.

Until this issue is carefully sorted out and PASS aspirations for these years becomes far more specific, there is little that can be said about long-term technical and economic feasibility. Cost estimates, at this time, are too soft for useful evaluation.

The above considerations should not keep PASS from forging ahead to satisfy urgent NRC/CNWRA needs.

PASS is a solid prototype, well and imaginatively administered by a small, determined systems staff. It stands an excellent chance for near-term success, productive growth, and future adjustment to altered circumstances if time can somehow be found, at this juncture, for the thorough CNWRA-wide planning and procedural work that needs to be accomplished and documented.

VI. SUMMARY OF CONCLUSIONS

1) A computer-based system is the best way to build the Program Architecture that is considered essential to the complex repository-licensing process. It can be readily justified economically.

2) Constructing that system through a prototype, using commercial software packages, is the most promising method of achieving rapid success, particularly in a fluctuating environment in which there are no precedents.

3) The PASS prototype is a solid achievement that is being improved and enhanced in ways that should maintain its flexibility for future growth and modification.

4) The cooperative use of SwRI's Central Computer Facility (CCF) has proved advantageous to PASS development.

5) The significant risks that PASS faces this year (1988) do not lie in any potential lack of hardware/software capability, but rather in the loading of data, where the preparation of essential procedures and a great deal of quality-controlled conceptual work will be required under accelerated deadlines.

6) The office-automation, management-information, and activity-tracking aspects of PASS do not appear to present any unusual software difficulties. It is the information-retrieval and system-connection aspects that will require closest attention.

7) NRC security requirements to keep sensitive data absolutely inviolate may force the CNWRA to employ a more costly, dedicated computer system, because there is no other sure way to protect that data from unauthorized access, if the CCF's existing networking remains intact.

8) PASS has excellent prospects for near-term success, productive growth and future adjustment to changing conditions. Judgments regarding long-term technical and economic feasibility may only be made as requirements become more fully defined.

VII. SUMMARY OF RECOMMENDATIONS

1) No significant changes should be made in PASS prototype software packages before December 1988, to assure that Program Architecture deadlines will be met.

2) Efforts should be focused at this time upon planning, procedures, documentation, and the building of a permanent, reliable IMS staff.

3) The Director/IMS should be fully involved in the creation of data entry procedures. His authorities may require some clarification.

4) Modification of the commercial software packages that constitute the PASS prototype should continue to be minimized to save scarce resources and retain flexibility for future system modification.

5) The CNWRA should continue to work closely with the NRC in 1988-1989 to assure that the best possible mutual, integrated use of PASS will be made.

6) As requirements for PASS are more fully defined, more capable IBM and non-IBM commercial software should be evaluated for possible incorporation in 1989 and beyond. This should apply to hardware as well.

7) Privileged documents should be kept (temporarily) by originators themselves, rather than stored in PASS, which will have limited protective capabilities.

8) The CNWRA would benefit from policy guidance from the NRC regarding the desired role PASS should play in relation to other systems under development for the support of repository licensing - the Licensing Support System (LSS) in particular.