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DATA ACQUISITION AND MANAGEMENT SYSTEM FOR SUPERPHENIX FUEL ELEMENT MANUFACTURING AND INSPECTION RESULTS

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Quality Assessment

1 - INTRODUCTION

Today's stringent safety requirements and the specific nature of fast breeder reactor plutonium fuel elements (i.e. the mass of plutonium implemented, the fuel element configuration and the wide diversity of components involved) have motivated the development of an integrated acquisition and management system for Superphenix fuel fabrication and inspection data. This system is foundamental in ensuring that fuel quality standards are met, and in providing continuous and accurate product status information during the fabrication process for plant safety purposes.

2 - BASIC SYSTEM DESIGN PRINCIPLES

The system was designed within the scope of our Quality Assurance organization, the purpose of which is to ascertain that the product complies with specification requirements. The two underlying concepts are traceability and quality assessment.

2-1 - Traceability

"Traceability" implies that each product or component can be identified, related to its specification requirements and located at any time during the fabrication process, and that all relevant background information can be called up when required.

Complete date is that available for each component : on one side input materials or products, design specifications and on the other side, manufacturing parameters, measurement and test results, together with all related documents : inspection reports, descriptive documents, etc...

Given a fuel subassembly number, for example, it is possible to obtain positive identification of the steel melt batch used to manufacture the subassembly cladding tubes. Similarly, the characteristics of the PuO_2 batch used to fabricate a particular lot of fuel pellets can be unambiguously recalled.

2-2 - Quality Assessment

This concept covers all operations designed to evaluate the level of product compliance with specifications and tolerance limits. Quality assessment is based on processing the measurement and test results for a set of characteristics in accordance with predetermined quality control procedures.

For example, individual measurements on a random sample of fuel pellets are used to determine the quality level of the entire pellet batch with regard to the measured properties. Similarly, the quality control codes noted during the various steps of the welding inspection procedure for a fuel pin form the basis for accepting or rejecting the pin in so far as welding is concerned.

The overall fuel quality level is determined from the comprehensive assessment of all such quality control data.

2-3 - Product Management

From a safety standpoint, this system is a significant aid in assuring an accurate and continually updated product inventory at all stages of the fabrication process : input, process operations, scraps and wastes, retentions, etc... It is also possible to check compliance with safety requirements concerning fissile material handling, even though the operator remains fully responsible for such operations.

3 - SYSTEM DESCRIPTION (Figure 1)

Each component part is individually identified, and fabrication of the initial Superphenix core involves processing some 15 million data items (table 1). Under these conditions, it is clear that powerful data processing means are required.

The system uses an IBM 34 computer in the fuel fabrication plant together with the CADARACHE CISI * network. The data acquisition and management system comprises three operational levels : data acquisition & transmission, data processing, files & status reports.

3-1 - Data Acquisition and Transmission

Data inputs are received from the fabrication and inspection stations in two ways :

- . by means of data forms compiled in accordance with fabrication and computer requirements ; the various categories of forms correspond to the major components or fabrication and inspection operations ;
- . by means of dedicated minicomputers at specific work stations, used for initial processing of results and, in some cases, for process control.

The data entry into the processor is via IBM 34 consoles equipped with printers to provide a hard-copy check of the input data. All data inputs and transmissions are identified by the operator's code.

3-2 - Data Processing

The data is compiled by the local processor which implements specific programs for the following tasks :

- . control testing and quality level assessment at each stage of fabrication,
- . data sorting by topical categories,
- . printing of test results and fabrication control documents for decision making purposes.

The operator responsible for each sector checks and validates all data at the local level.

3-3 - Files and Reports

The validated data is stored on file disks in the central processor, and constitutes the bases for preparing the required reports.

* CISI : Compagnie Internationale de Services en Informatique

. Quality Control Reports

- Inspection reports based on systematic processing of all data related to specifications compliance,
- Quality evaluations,
- Overall quality assessment documents.

. Descriptive Reports

- Delivery information,
- Traceability documents,
- Fabrication process documents.

. Material Reports

- Material balances,
- Inventories.

. Progress Reports.

4 - QUALITY ASSESSMENT

The quality assessment confers particular significance to this mass of data and represents a valuable decision-making aid and source of information on the fuel before and after irradiation. Applications of this quality assessment can be found at several levels.

4-1 - Fabrication

By correlating inspection statistics (mean values, variance, etc...) with the fabrication parameters it becomes possible to optimize quality procedures and to implement preventive action.

4-2 - Quality control

Quality reports based on systematic analysis of all available data

constitute proof of product conformity. In addition, certain statistical analyses can be used to redirect individual inspection operations.

4-3 - Design

This quality analysis is of considerable importance to the project engineer, who is then better able to determine precise fuel performance characteristics and to specify certain project values.

Moreover, correlation established between fuel properties and in-pile behavior will provide valuable new information for fast breeder reactor fuel development.

5 - CONCLUSION

The different aspects of this system discussed here are indicative of its importance within the scope of industrial processes such as Superphenix fuel fabrication. The formalism and computerized methods entailed by this system help to ensure compliance with the specified procedures. It represents an effective means for obtaining product conformity and constitutes a valuable decision-making aid.

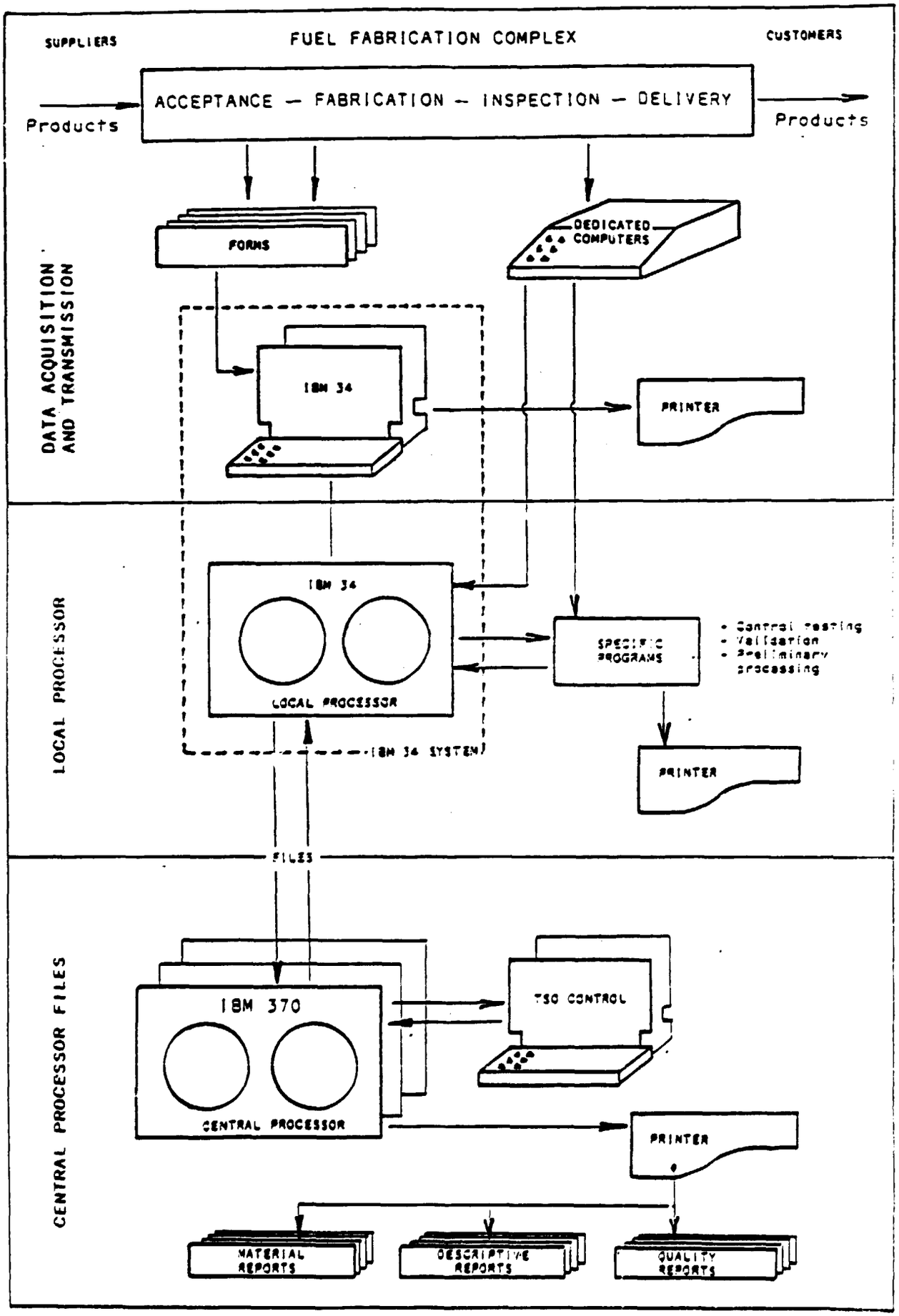
SUPPLIERS
FUEL FABRICATION COMPLEX
CUSTOMERS
ACCEPTANCE — FABRICATION — INSPECTION — DELIVERY
Products
Products
DATA ACQUISITION AND TRANSMISSION
FORMS
DEDICATED COMPUTERS
IBM 34
PRINTER
LOCAL PROCESSOR
IBM 34
LOCAL PROCESSOR
IBM 34 SYSTEM
SPECIFIC PROGRAMS
• Control testing
• Validation
• Preliminary processing
PRINTER
FILES
CENTRAL PROCESSOR FILES
IBM 370
CENTRAL PROCESSOR
TSO CONTROL
PRINTER
MATERIAL REPORTS
DESCRIPTIVE REPORTS
QUALITY REPORTS

Figure 1

NUMBER OF	FUEL PELLETS	FUEL PINS	FUEL SUBASSEMBLIES	TOTAL FOR SUPERPHENIX 1
CONTROL TYPES	per batch: 27	per pin: 37	per subassembly : 35	approx 100 (1)
CHARACTERISTICS PROCESSED	per batch: 42	per pin: 37	per subassembly : 35	
DATA INPUTS	per batch: approx 850	per pin: approx 140 (2)	per subassembly : approx (2) 50	
BATCHES OR PRODUCTS	apprcx 1000	approx 100 000	approx 400	
TOTAL DATA	$0,85 \times 10^6$	14×10^6	$0,02 \times 10^6$	approx 15×10^6

(1) without the acceptance control of supplyings

(2) some caracteristics are controled per batch or sample

TABLE 1 : NUMBER OF DATA ACQUISITION