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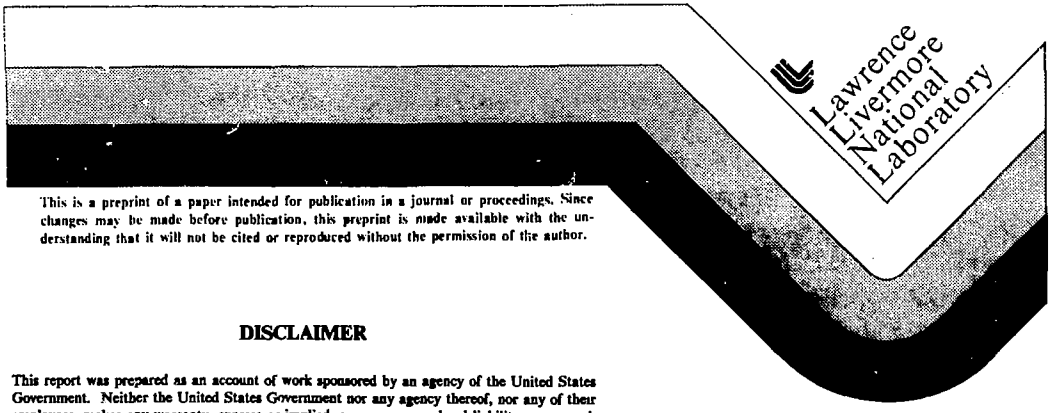


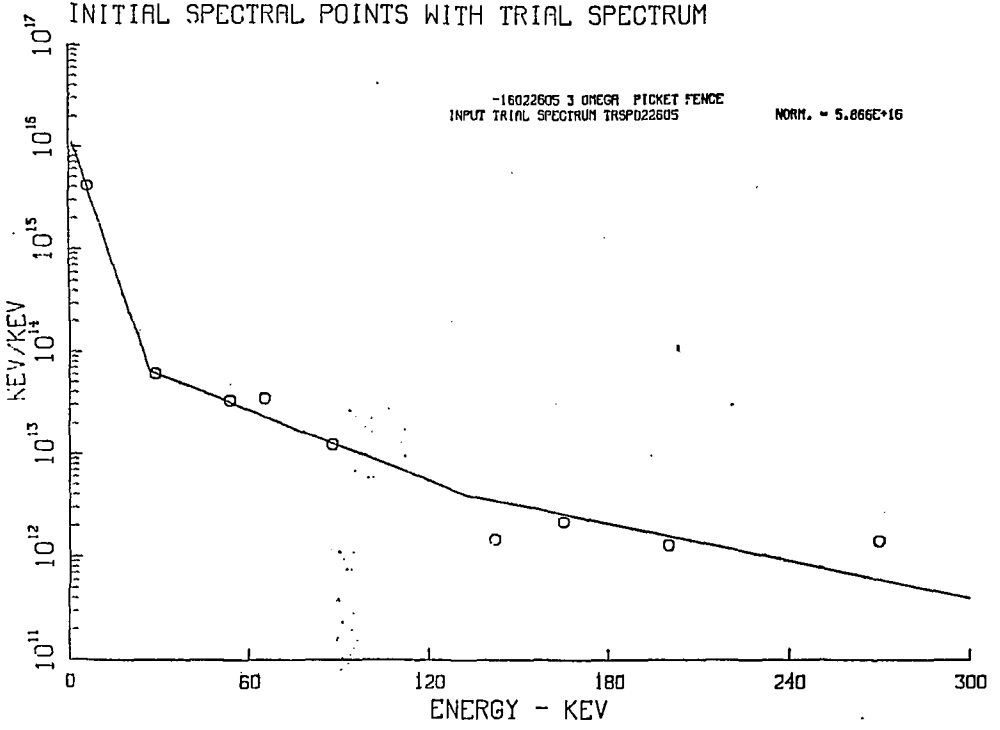
DISCLAIMER

HIGH ENERGY X-RAY SPECTRUM
(FFLEX)

SYSTEM FFLEXR CHAMBER R

16022605
ACTIVATE
PICKET
PAGE 1/2

UNSPEC UNFOLD: R1 UNR022605.SR1
INITIAL SPECTRAL POINTS WITH TRIAL SPECTRUM



HALF-KEV	J/KEV 4PI INTEGRAL	
6.200×10^{4}	4.215×10^{15}	
2.900×10^{4}	6.182×10^{14}	
5.381×10^{3}	3.390×10^{14}	
6.537×10^{3}	3.520×10^{14}	
1.420×10^{3}	1.488×10^{14}	
8.803×10^{2}	1.263×10^{14}	
2.000×10^{3}	1.311×10^{13}	
2.700×10^{3}	1.429×10^{13}	
1.650×10^{3}	2.214×10^{13}	5.052×10^{15}

NONZERO BUT INSIGNIFICANT SIGNAL SEEN IN ONE NOISE CHANNEL
T-hot = 37.5 keV E-hot = 0.10 kJ
T-SH = 72 KEV E-SH = 0.040 KJ

Checked: JACKSON
04-MAR-86

SUMMARY OF CONTROL AND DATA ACQUISITION SYSTEMS FOR NOVA EXPERIMENTS*

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Abstract

The Nova Laser has completed its first year of operation. During this period, emphasis has been placed on activation of the facility and of the numerous target and beam diagnostics. Two separate target chambers are in use.

Nova operation is separated into two broad functions: Laser Operations and Experiments. The Operations Group provides the laser system control, operation and data acquisition and the Experiments Group provides experiment definition, diagnostic instrumentation and overall data processing.

On the Operations side, VAX 11/780 computers are used to set up diagnostic operating parameters and collect data recorded by the CAMAC and CCD modules. These data are delivered in files by electronic link to the Laser Experiments and Analysis Facility (LEAF) VAX 11/785 of the Experiments Group for processing. Film data are digitized at LEAF and the film data files are also processed on the LEAF VAX.

The LEAF provides collection, processing, analysis and archiving of the experimental data. The many applications software packages written for LEAF provide the experimental physicists and Nova Operations staff with programs and data bases for interpretation of experimental results. This software makes fundamental use of the ORACLE Relational Data Base Management System to both access the required data and archive the obtained results.

Post-shot data processing produces sets of scalar values, x, y profiles and x, y, z contour data. The scalar data are stored in the ORACLE DB; the more extensive results are stored in binary files on disk. All data forms are accessed by a comprehensive software system, the Electronic SHOTBOOK, developed around the ORACLE DBMS. This software also provides the means to archive relevant data about each experimental activity and allows the physicists to annotate displayed experimental results with technical comment.

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Introduction

This paper concerns the development, flow, and use of experimental data at the NOVA facility. For this purpose we will give an over view of the experimental system, i.e., the Target chambers and the related Diagnostic systems; some ideas about the scope and bases for experimental planning; experiment rates; the overall data flow system; and our main method of data utilization.

NOVA is a high energy Nd glass Laser Research facility. The Laser system consists of ten beams each of which can deliver ~ 8 to 15 Kj (pulse length >2 nsec) in a final diameter of 74 cm to the final focussing lens and with frequencies of 1.05, 0.53 or 0.35 μm on to the target located at target chamber center. As shown in Fig. 1 the NOVA facility supports two separate target chambers, a ten-beam chamber (4.4 m in diameter) and a smaller two-beam chamber (1.6 m in diameter). As shown in Tables I and II these target

chambers presently support numerous active light sensing as well as x-ray and neutron diagnostics, with several more in process of installation or development.

The NOVA control system is distributed according to major subsystems which include alignment/diagnostics, pulse generation, amplifier chains, beam transport, frequency conversion, target systems and data acquisition as shown in Fig. 2. That these control systems are highly automated is evidenced by the fact that only six to ten people are required to accomplish a full ten beam target shot - an activity which ranges from complete laser and target alignments, setting of pulse energy/shape/duration, complete laser diagnostics support, a rod-shot check of the pulse energy/shape/duration at the front end to the actual target shot with complete data acquisition.

Planning for experiments (or shots as they are commonly called) is a true multi-disciplinary activity which involves theoretical calculations to develop experimental goals and expectations; scientific experiment

design to select both beams and their frequencies as well as specification of the often complex target/shield systems; engineering design and fabrication of the target system, including its in-chamber support and alignment; and scientific diagnostics design with complete preshot performance analyses based on actual as-installed-component calibrations.

Initial scientific activation of the NOVA Laser facility began in April of 1985. As a result of the many diagnostics instruments installed in the ensuing months, an increased experimental activity was begun in September of 1985. This has resulted in some 100 target shots completed in the ten-beam chamber and 74 target shots done in the two-beam chamber. Experimental campaigns are now in progress which will increase the weekly target shot rates to about ten (10) in the ten-beam chamber and six (6) in the two-beam chamber. It should be noted that these shot rates have their limitation in the experimental complexity not in the laser system and that, due to the system's design flexibility, the beams can be diverted to either chamber for separate or simultaneous shots. As has been true for several months, all data

handling systems are in place and fully operational: acquisition, transfer, processing, archiving and review.

Data Processing and Archiving

Following a target shot, the acquired raw digital data are sent to the Laser Experiments and Analysis Facility (LEAF) via a unique one-way data link - as required by our security system since the shot may be of a classified nature. The extensive film data are also brought there (by foot-net) after its development. The LEAF, shown schematically in Fig. 3, provides a PDP-11/34 supported PDS microdensitometer for digitization of the film and transport of the resulting files to the disks of the "main" computer, a VAX 11/785. Fortran based in-house developed processing codes are then used to make "calibrated" data files and provide graphical/tabular hard copies of the raw digital data as well as graphics terminal compatible files from the PDS processing. In addition, these processing codes also archive the files onto the proper hard

disks and insert, for the data from each diagnostic instrument, the shot number, target chamber identification, diagnostic symbol name and key results information along with the data file name(s) into the relevant table(s) of the ORACLE relational data base. These database then form the foundation upon which our final-data retrieval and usage methodology software system is based. An overall schematic of these functions - from experiment preparation to data review is shown in Fig. 4. It is of interest to note that some 24 Mb of data are collected from a ten-beam shot and about eight Mb from a two-beam shot.

Annotation and Review of Final Data

A comprehensive software system called the Electronic SHOTBOOK has been developed to provide timeliness, consistency and availability of experimental results from the NOVA facility. Operating on all terminals of the LEAF, this program provides a user oriented system for review of the experimental data and related updating for archival purposes. It is Fortran

based, menu driven, designed around the ORACLE relational database and offers complete data integrity protection through database access controls. This latter feature, transparent to the users, provides selection by any user of any and all data for review but allows only those with particular responsibilities for a shot, e.g., shot physicist or diagnostic physicist, to write or modify shot summaries or provide technical annotation to particular data displays.

The annotation feature is basic to the usefulness of the data displayed by the Electronic SHOTBOOK since it provides for them consistent Shot, Series and Subseries identification, proper definition of the diagnostics fielded on each Shot, definition of the target used, in addition to the above mentioned detailed Shot summaries and technical comments placed on each displayed diagnostic result. Not withstanding all of these features which ensure data integrity, the Electronic SHOTBOOK is remarkably easy and fast to use.

Following a password protected logon, the SHOTBOOK user is presented with a succession of menus as in Fig. 5 which directly lead to a

Table of Contents (Fig. 6) for data from a selected Shot. Although many alternatives are offered throughout SHOTBOOK, each only requires a single key-stroke to accomplish. Here as an example, we choose to review data from the high energy x-ray spectrometer with the system identification "FFLEXR". The resulting fully annotated data display is shown in Fig. 7. Similar detailed data displays, custom designed for their purpose, are provided for the other items in the Table of Contents. Some are rather more extensive; the KB x-ray microscope display handles some 4 Mb of data on a single frame and the Laser Beam Pulse Shapes display offers six pages of data display in detailing both incident and reflected beam pulse shapes for each beam as well as for the east and west banks of five each.

Conclusions

Data flow from the NOVA laser facility is now well established and routinely functioning. The LEAF VAX is supported by some 28 Mb of physical memory to ensure a high degree of interactivity to our approximately 60 users and currently carries 3.8 Gb of hard disk

storage to maximize the amount of on-line experimental data. Although backed-up regularly to magnetic tape for safety, all data obtained to date from the NOVA work remains on-line and readily available to the user community.

Table I. Nova 10-beam target chamber diagnostics

Diag. Symbol	Description
EBM	Energy balance module
LBEAMS	Laser beam pulse shapes
CUACT(2)	Copper activation neutron detector
OPD(2)	Opposed port beam diagnostics
SOP	Streaked optical pyrometer
SOS(2)	Streaked optical spectrometer
Dante(2)	Low energy x-ray spectrometer
FFLEX	High energy x-ray spectrometer
8X(2)	KB x-ray microscope
HNWY(2)	Henway crystal spectrograph
Ox-OPT	Optical streaked camera
PINHOL(2)	X-ray imaging pinhole camera
SCS	Streaked crystal spectrometer
SDSS-1	Spatially discriminating streaked spectrograph
MOR-OF	MOR - optical fiducial

Table II. Nova 10-beam target chamber diagnostics

Diag. Symbol	Description
LBEAMS	Incident/reflected laser energies
HENWAY(2)	Henway crystal spectrograph
MCPIGS(2)	Microchannel plate incidence grazing spectrometer
PHC(2)	X-ray imaging pinhole camera
TGSS	Spectrometer transmission grating streaked
SCS	Streaked crystal spectrograph
OIC	Optical imaging camera
LBIXS	Large bandwidth imaging x-ray spectrometer

Figure Captions

Fig. 1. Nova high energy laser facility

Fig. 2. Nova control system architecture

Fig. 3. Laser experiments analysis facility

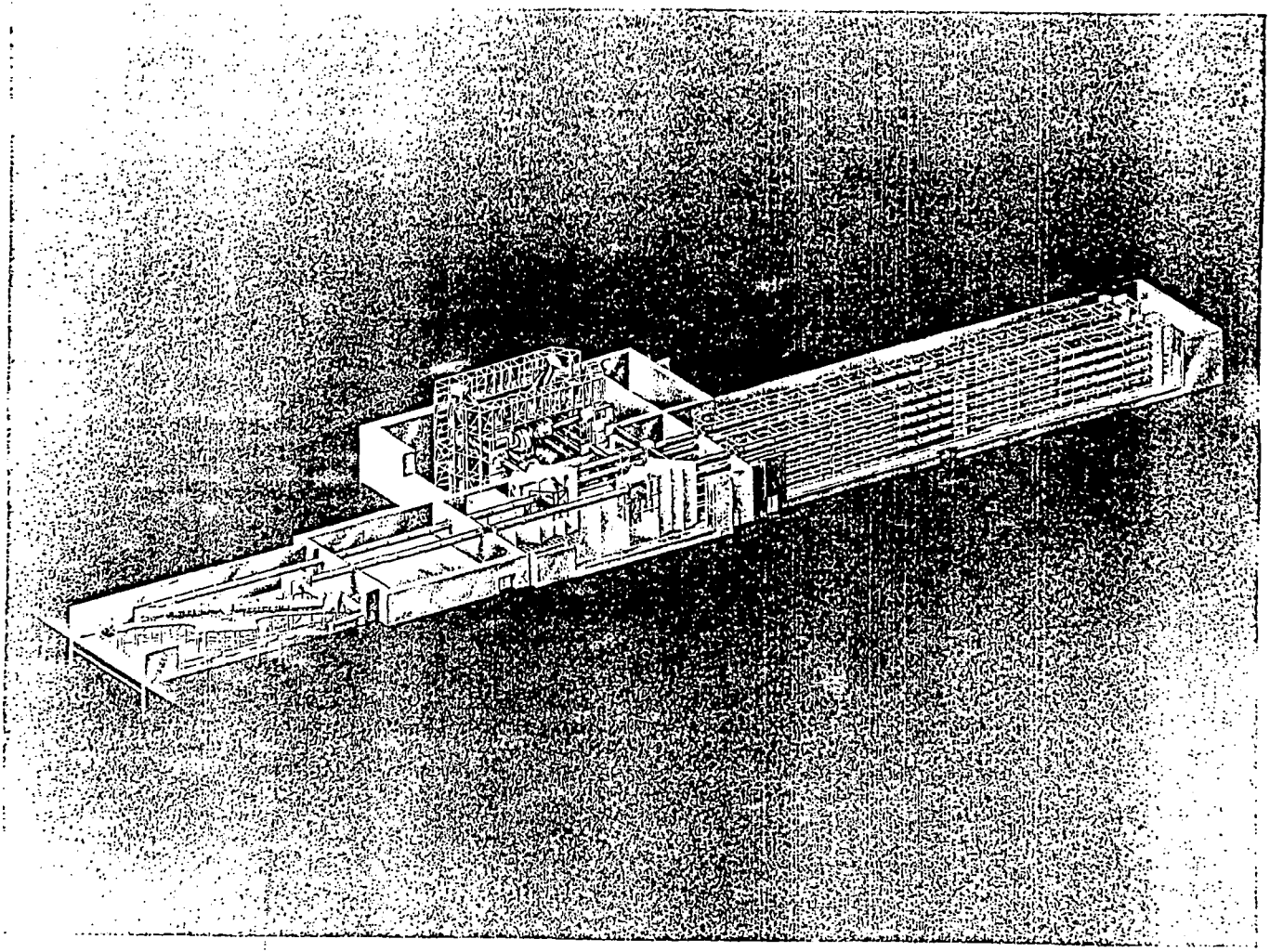
Fig. 4. Schematic of overall data flow

Fig. 5a. Initial shotbook menu

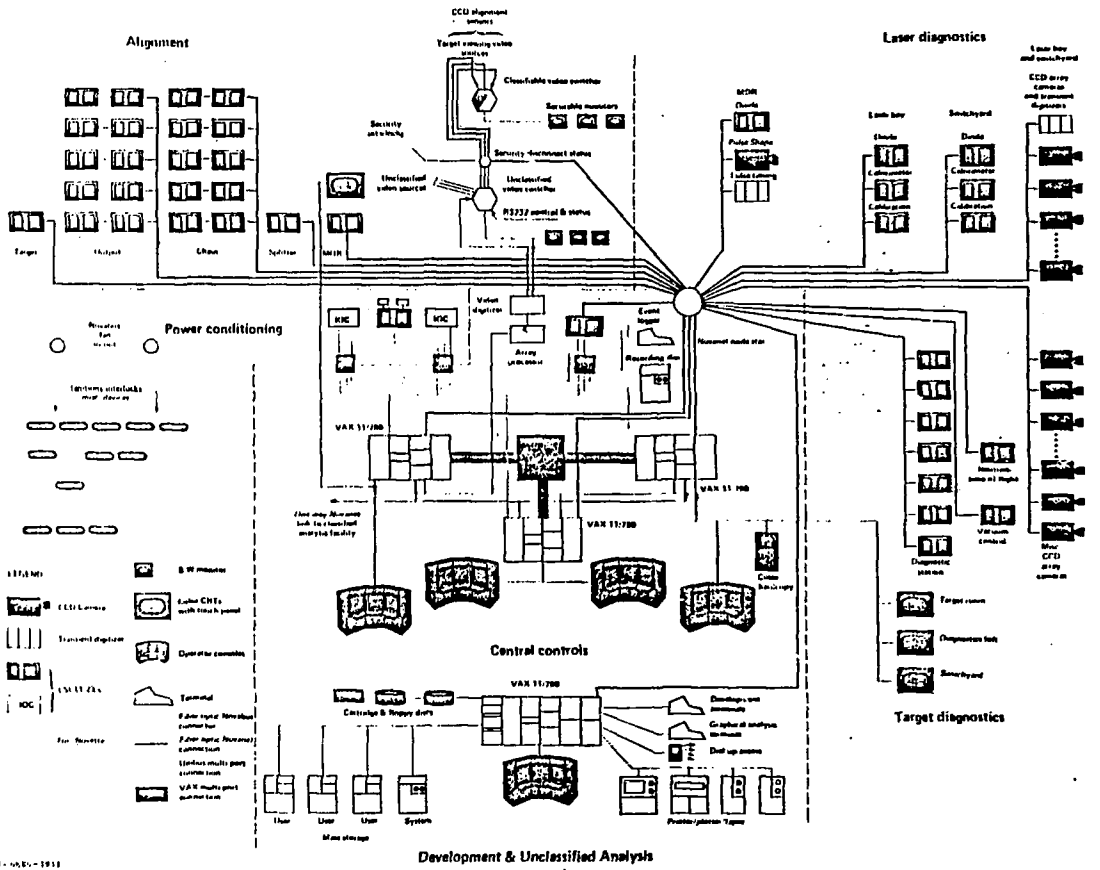
Fig. 5b. Typical selection menu

Fig. 6. Typical Table of Contents menu

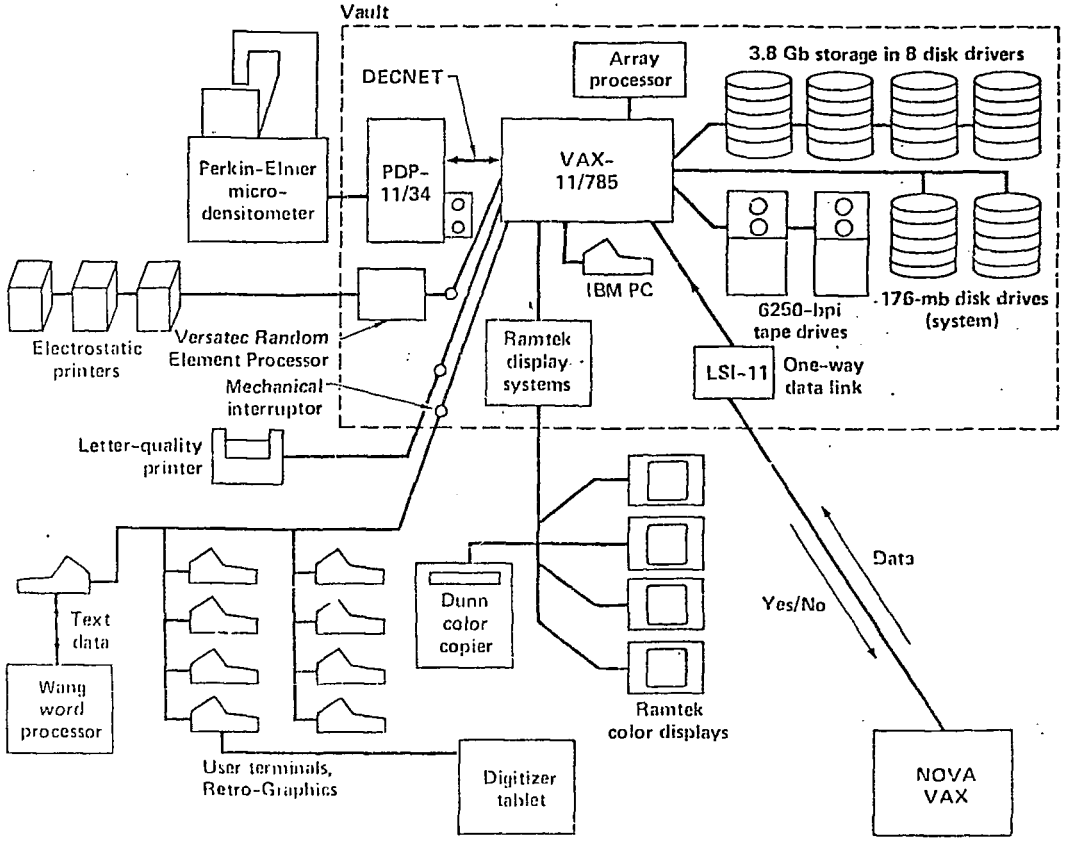
Fig. 7. Typical shotbook data display

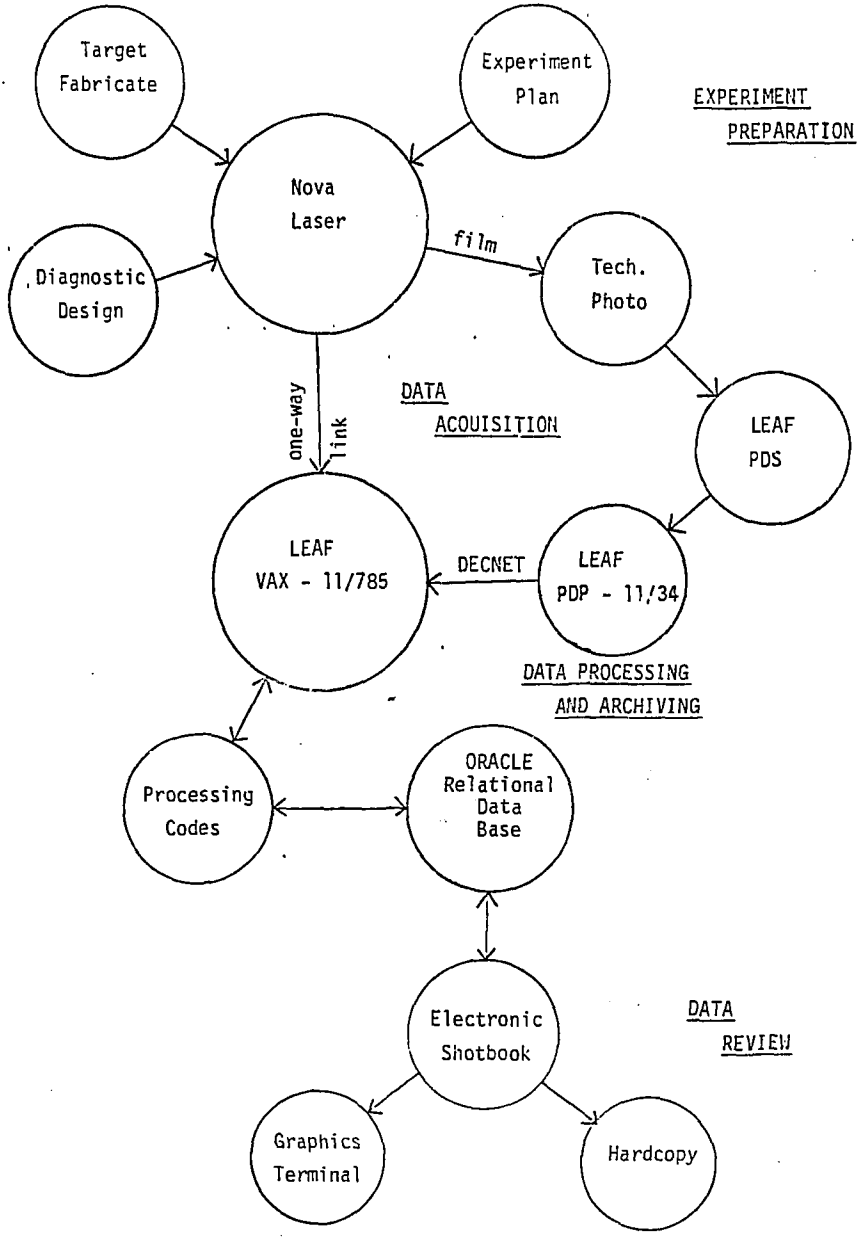


NOVA CONTROL SYSTEM ARCHITECTURE



Laser Experiments Analysis Facility




Target Fabricate
Experiment Plan
EXPERIMENT PREPARATION
Nova Laser
film
Tech. Photo
Diagnostic Design
one-way link
DATA ACQUISITION
LEAF PDS
LEAF VAX - 11/785
DECNET
LEAF PDP - 11/34
DATA PROCESSING AND ARCHIVING
Processing Codes
ORACLE Relational Data Base
Electronic Shotbook
DATA REVIEW
Graphics Terminal
Hardcopy

LASER EXPERIMENTS ANALYSIS FACILITY
** Electronic SHOTBOOK **

MAIN OPTIONS MENU

- Examine Shot Results
- Update Shot Results
- Display Available Diagnostics
- Shotbook Maintenance
- Exit Program

Press <PF2> key for help.

LEAF Electronic SHOTBOOK
** EXAMINE SHOT RESULT OPTIONS MENU **

TABULAR RESULTS AND GRAPHICS DISPLAYS

- List Shot Series
- List Shot Subseries
- List Shot Numbers
- Display Shot Table of Contents
- Display Section Results

LEAF Electronic SHOTBOOK

** SHOT TABLE OF CONTENTS **

SHOT: 16022605 SERIES: ACTIVATE SUBSERIES: PICKET # OF SYSTEMS: 14

CHAMBER: R

	SYSTEM	DIAGNOSTIC DESCRIPTION	REF CHAMBER
_	TSUMRY	SHOT SUMMARY TEXT (NOVA I)	
_	LBEAMS	LASER BEAM PULSE SHAPES (NOVA)	
_	EBSUM	ENERGY BALANCE SUMMARY (NOVA)	
_	SOP-1	STREAKED OPTICAL PYROMETER (SOP-1)	
_	SOS-1	STREAKED OPTICAL SPECTROMETER (SOS-1)	
_	SOS-2	STREAKED OPTICAL SPECTROMETER (SOS-2)	
_	FFLEXR	HIGH ENERGY X-RAY SPECTROMETER (FFLEXR)	
_	8X-E	KB X-RAY MICROSCOPE (8X-E)	
_	8X-W	KB X-RAY MICROSCOPE (8X-W)	
_	HNWY-1	HENWAY CRYSTAL SPECTROGRAPH (HNWY-1)	
_	OX-OPT	OPTICAL STREAKED CAMERA (OX-OPT)	
_	PINHOL	X-RAY PINHOLE IMAGING CAMERAS (PHC1/2/3)	