ROCHESTER INSTITUTE OF TECHNOLOGY
MICROELECTRONIC ENGINEERING

Introduction to MESA

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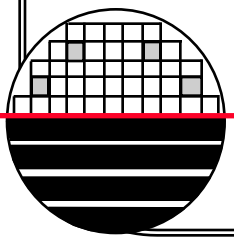

ADOBE PRESENTER

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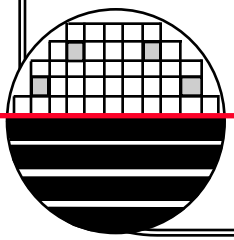
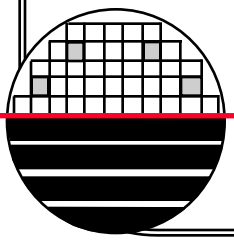


OUTLINE

Introduction to MESA
Hardware
Software
User Interface
MESA Factory Organization
Operations
Processes
Products
Masks
Data Base Query
Reports
SPC Charts
Homework



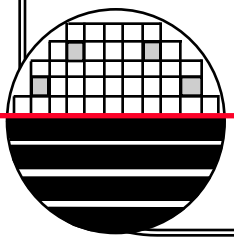
MESA - MANUFACTURING EXECUTION SYSTEM APPLICATION

MESA is an integrated relational database system for discrete part manufacturing (a computerized record-keeping system)

A relational database system is a database in which the data is perceived by the user as tables (and nothing but tables)

Operations include:

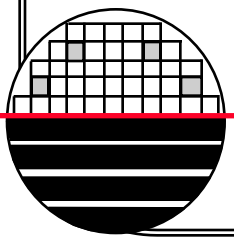
- **Adding new tables to the database**
- **Inserting new data into existing tables**
- **Retrieving data from existing tables**
- **Updating data in existing tables**
- **Deleting data from existing tables**
- **Removing existing tables from the database**
- **Quarrying database tables for specific information**



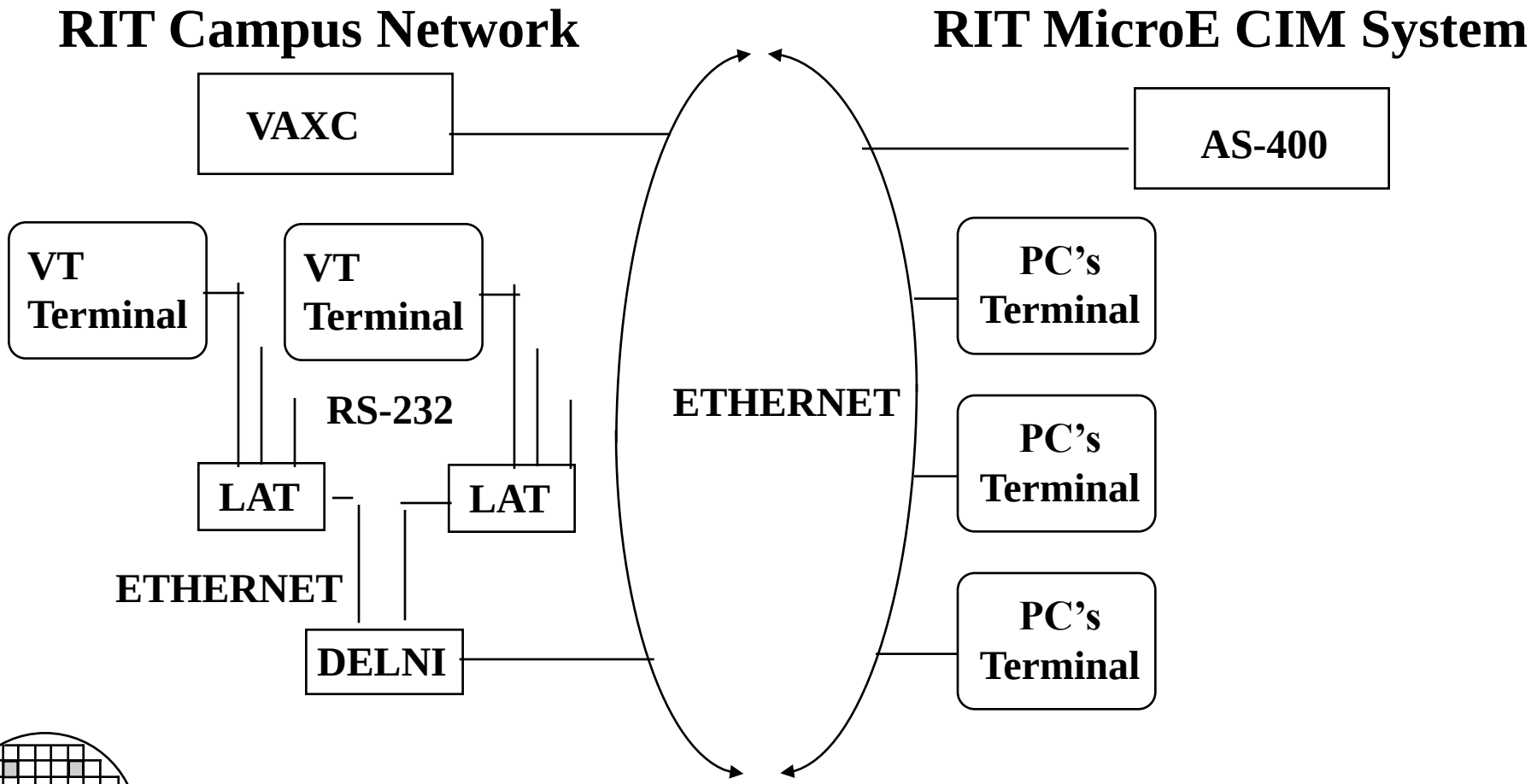
MES CIM SYSTEMS

CIM SYSTEM

- **AS/400**
- **Qty 10 PC Workstations**
- **Ethernet LAN**
- **Quality Analyst Software**
- **MESA Software (Manufacturing Execution System Application)**
  - **Work-in-process Tracking**
  - **Transaction Processing**
  - **Production Costs**
  - **Scheduling**
  - **Statistical Process Control**
  - **Resource Management**
  - **On-Line Reporting**
    - **Lot Status**
    - **Transaction History**
    - **Data Collection**
    - **Specifications and Instructions**



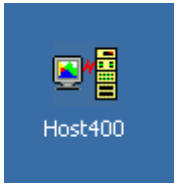
CIM SYSTEM HARDWARE

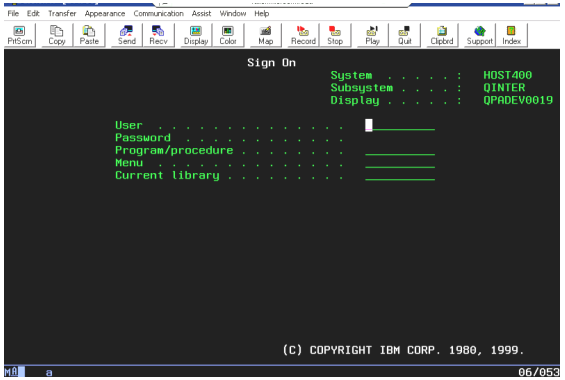


CIM SYSTEM - PC WORKSTATION

ACCESS TO AS-400 AND MESA

The computers in the clean room have an icon on the desktop that will connect the user to the AS400 sign on screen:

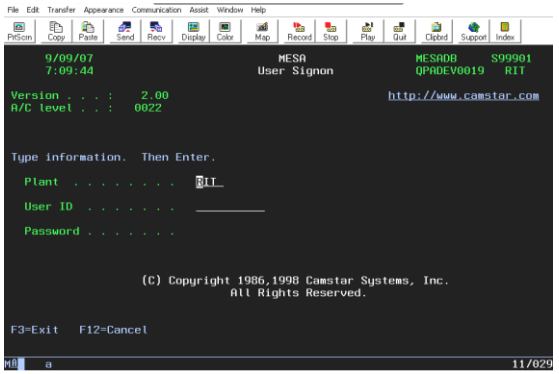




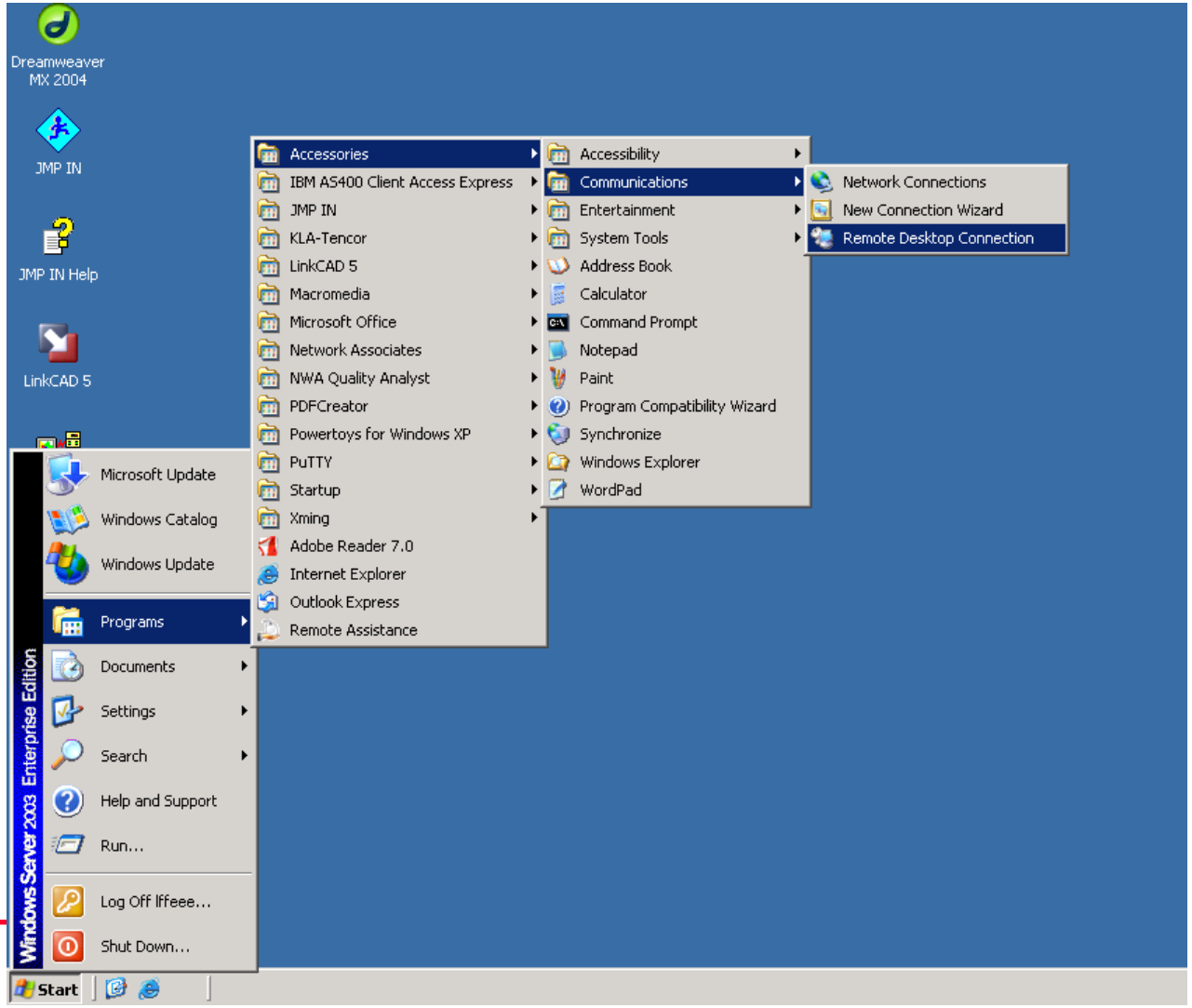
Username is STUDENT
password is NIGHTSHIFT

Next the user signs on to the MESA software:

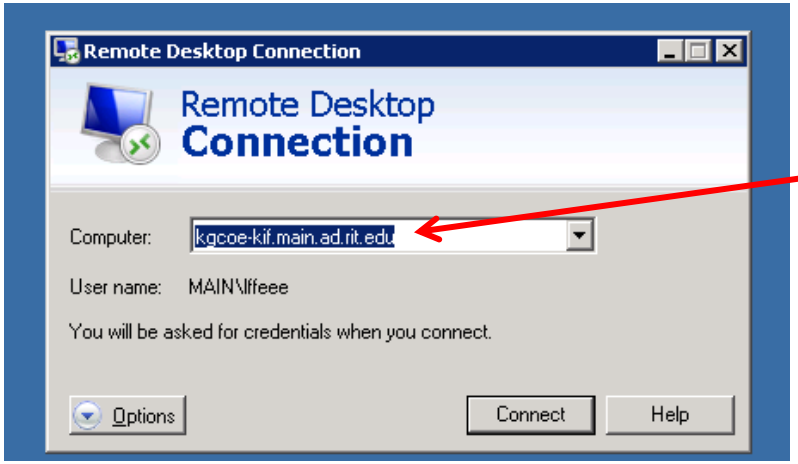
Username is OPERATOR
password is OPERATOR



START UP REMOTE DESKTOP



LOG ON TO KIF SERVER, START UP MESA

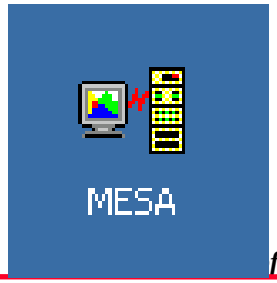


Type in kgcoe-kif.main.ad.rit.edu

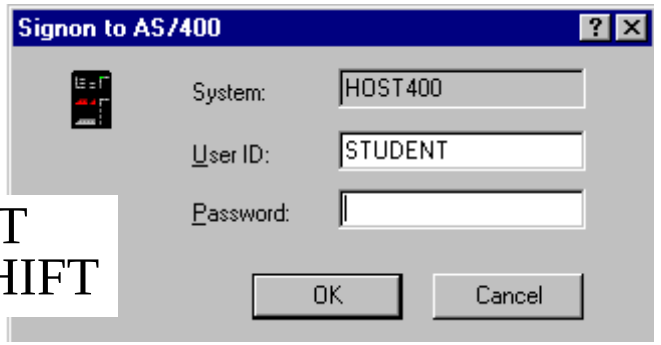
Click Connect

Then: Enter DCE Username and Password
(all registered students should have this)

Then: Click on MESA Icon



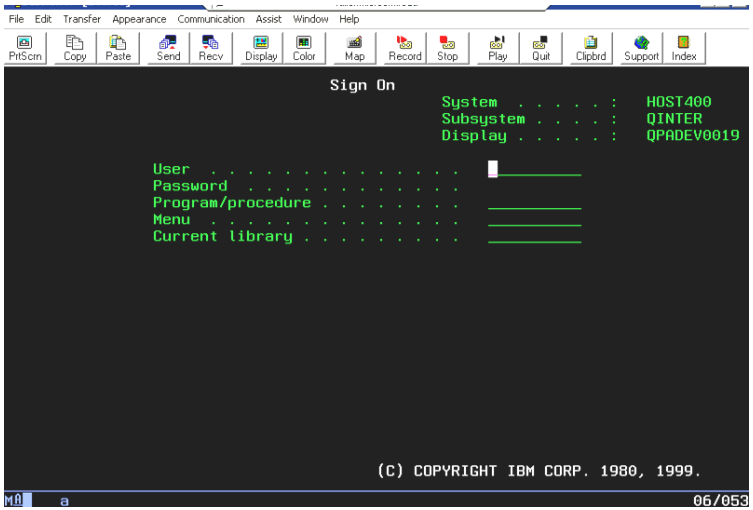
Sign onto AS400:



STUDENT
NIGHTSHIFT

SIGN ON TO AS400 AND MESA SOFTWARE

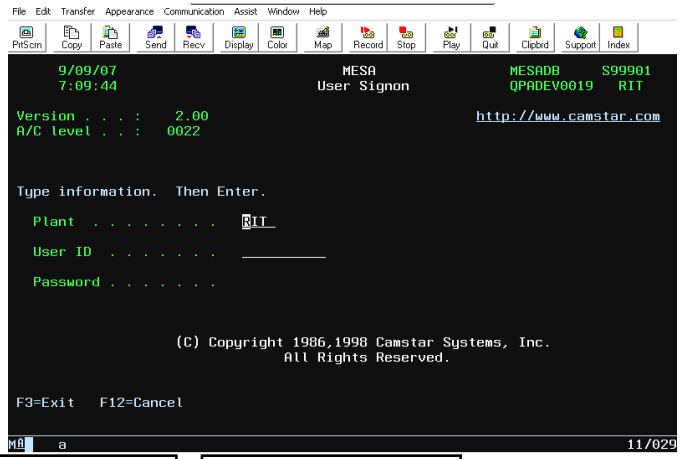
AS400 sign on screen: Sign on again



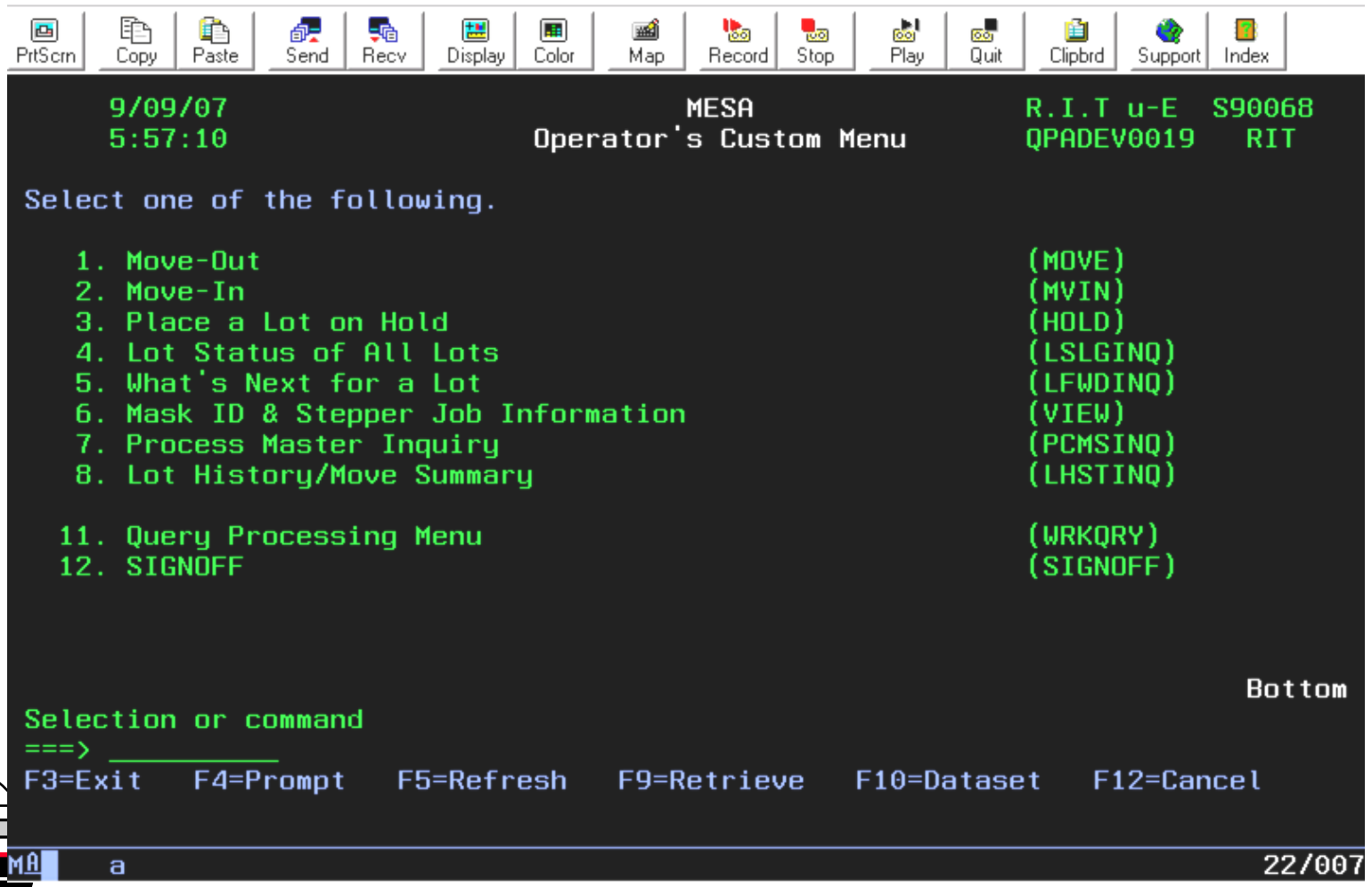
Username is STUDENT
password is NIGHTSHIFT

Next the user signs on to the MESA software:

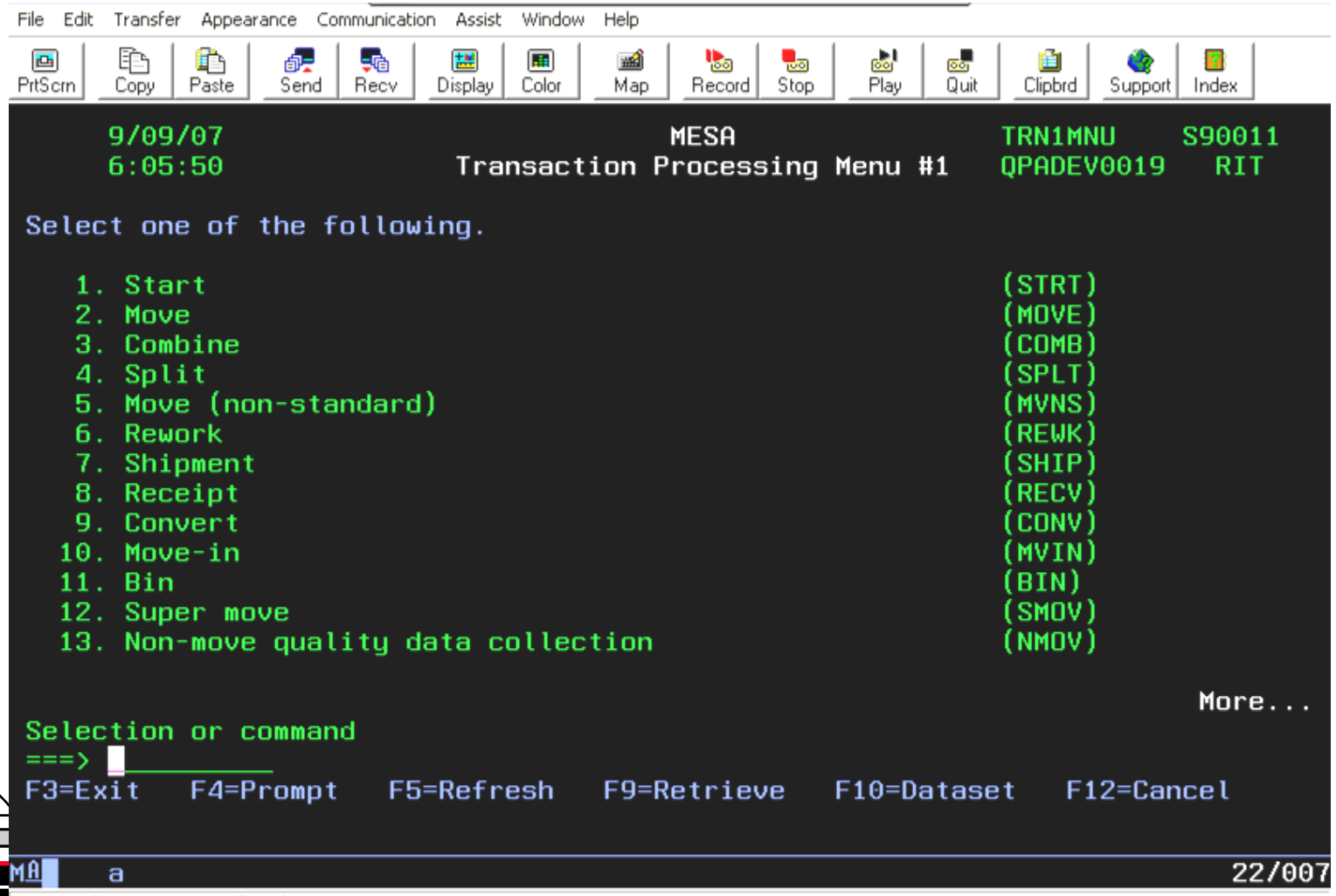
Username is OPERATOR
password is OPERATOR



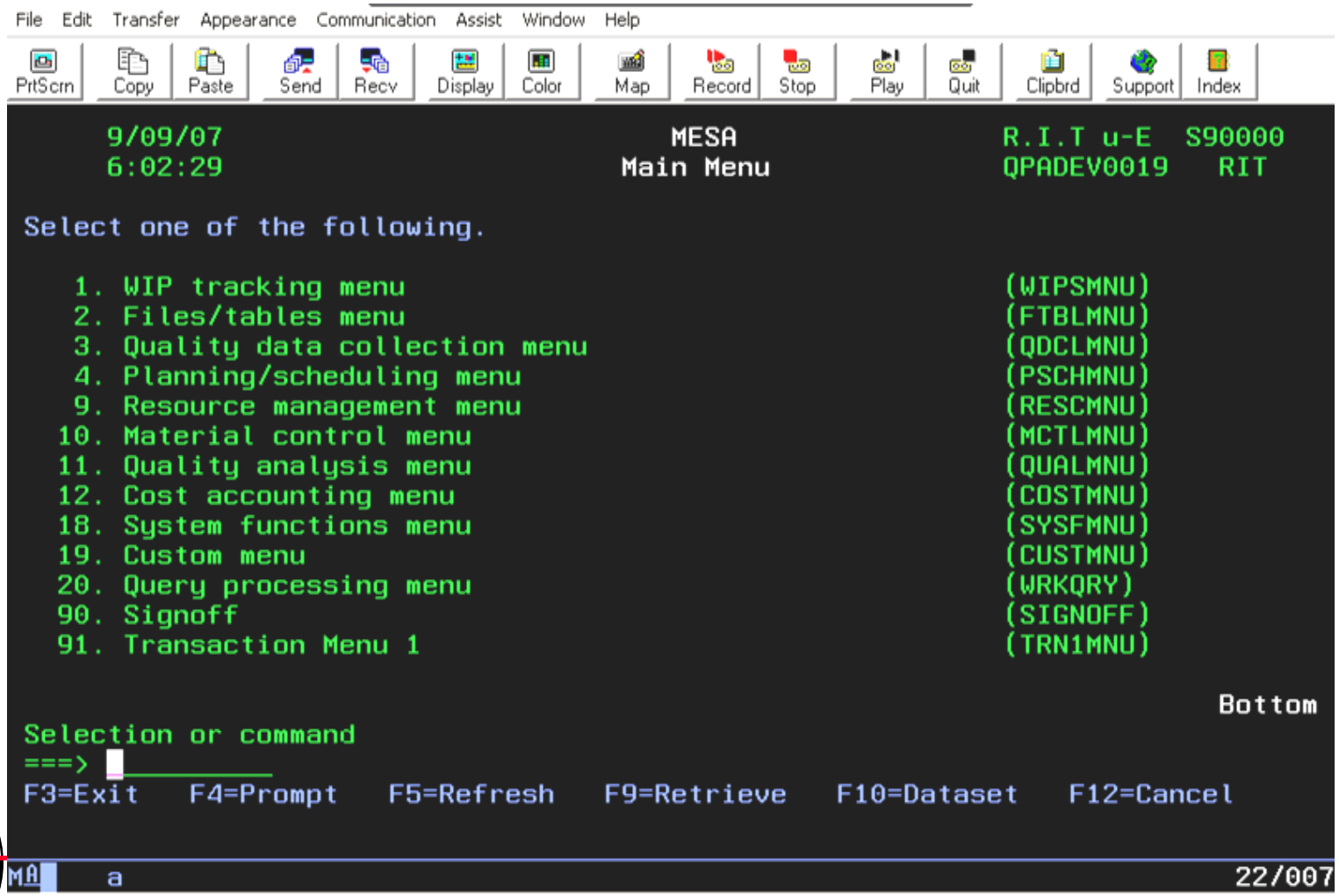
OPERATOR USER INTERFACE



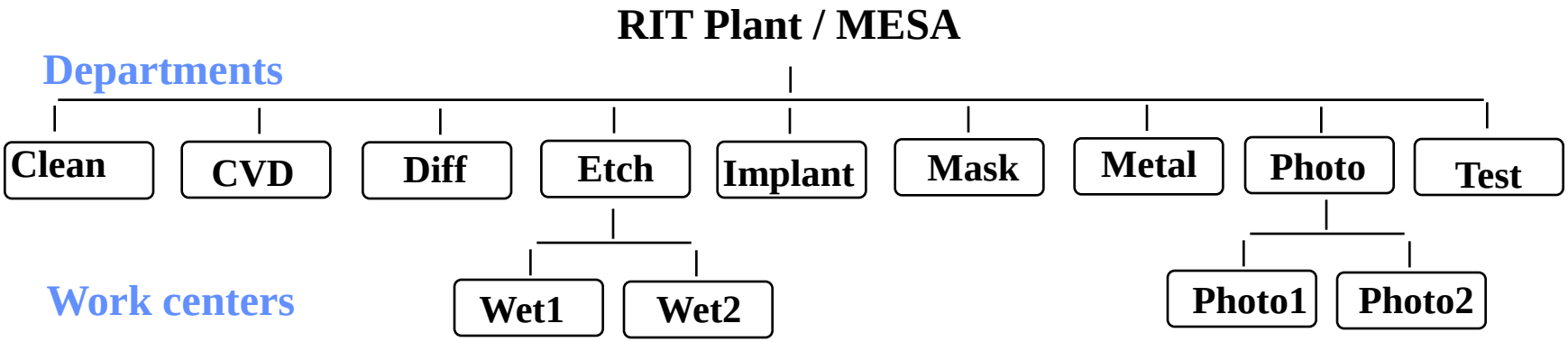
ENGINEER USER INTERFACE



FACULTY USER INTERFACE



MESA FACTORY ORGANIZATION



Resource Types Clean CVD Diff Etch Implant Metal Mask Photo Test

Resource ID's

FURNACE01
FURNACE02
.
.
FURNACE21

CVC601
P&E2400

STEPPER01
STEPPER02

Vendors
Customers
Accounts
Ship-to-Locations

RESOURCE HIERARCHY

RESOURCES

|

RESOURCE TYPE
(TOOLS, OPERATOR)

|

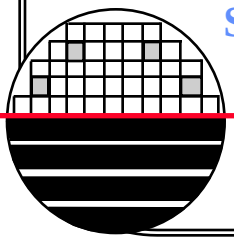
RESOURCE SUB TYPE
(ETCH, DIFF, PHOTO, ETC.)

|

RESOURCE ID'S

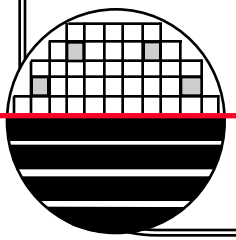
EXAMPLES:

RESOURCE ID	DESCRIPTION	SUB TYPE	TYPE
ANALYZER01	HP4145 PARAMATER ANAZ	TEST	TOOL
ASHER	TEGAL PLASMALINE 410	ETCH	TOOL
FURNACE01	GATE OXIDE GROWTH	DIFF	TOOL
NANOSPEC	OXIDE THICKNESS MEAS	TEST	TOOL
SKILL1	OPERATOR SKILL LEVEL 1	OPERATOR	OPERATOR
SKILL4	OPERATOR SKILL LEVEL 4	OPERATOR	OPERATOR
SKILL5	OPERATOR SKILL LEVEL 5	OPERATOR	OPERATOR



OPERATIONS

CL01	RCA Clean
CV01	LPCVD Polysilicon
CV02	LPCVD Silicon Nitride
CV03	LPCVD Low Temperature Oxide
DE01	Four point probe
DI01	p-type spin on diffusion
DI02	p-type spin on plus oxide growth
DI03	p-type from solid BN source
DI04	n-type spin on diffusion
DI05	n-type from solid P source
DI06	n-type spin on arsenic source
ET01	control wafer oxide step etch
ET02	oxide etch until pull dry
ET07	photoresist strip in asher
ET08	plasma etch polysilicon
ET09	plasma etch silicon nitride
ET10	plasma etch oxide
IM01	ion implant wafers
ME01	sputter aluminum
OX01	wet oxide 5000 A
OX02	dry oxide 600 A
OX03	dry oxide and anneal
OX04	wet oxide
OX05	dry oxide with TCA clean
OX06	dry oxide with TCA
OX07	post implant anneal
OX08	100 A tunnel oxide
PH01	1X Contact Printer
PH03	Photolithography on Stepper
SI01	Sinter
TE01	Test van der pauw, CBKR
TE02	Test transistors
TE03	Test integrated circuits
GR01	groove and stain
ID01	scribe wafers



MESA PROCESS DEFINITION

PROCESS CLASS
(MOS, BiPolar, MEMs)

PROCESS
(PMOS ver 1.O, CMOS ver PW-3)

STEPS
(STEP1 STEP2 STEP3 .....STEP78)

SPECIFICATIONS

DOCUMENTS

DOCUMENT TYPE
(TEXT, GRAPHICAL)

DOCUMENT
CLE01.FFT
SHIPLEY.IMG
SCRIBE.IMG

INSTRUCTION GROUP NAMES

OPERATION CLASSES

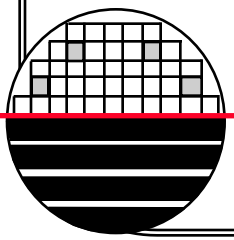
OPERATION

CL01	ET01
CV01	ET07
CV02	ET08
CV03	IM01
DE01	OX06
DI01	PH03
DI02	SI01
ET01	TE01

PARAMETER GROUP NAMES

PARAMETER TYPE
(ALPHA, NUMERICAL)

PARAMETER
(XOX)
(XJ)
TEMP
TIME
POWER

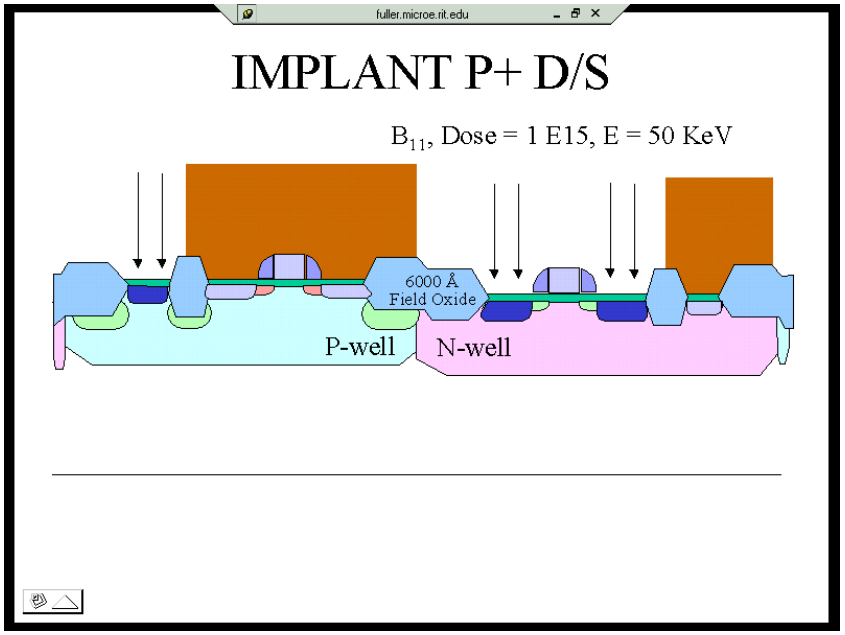


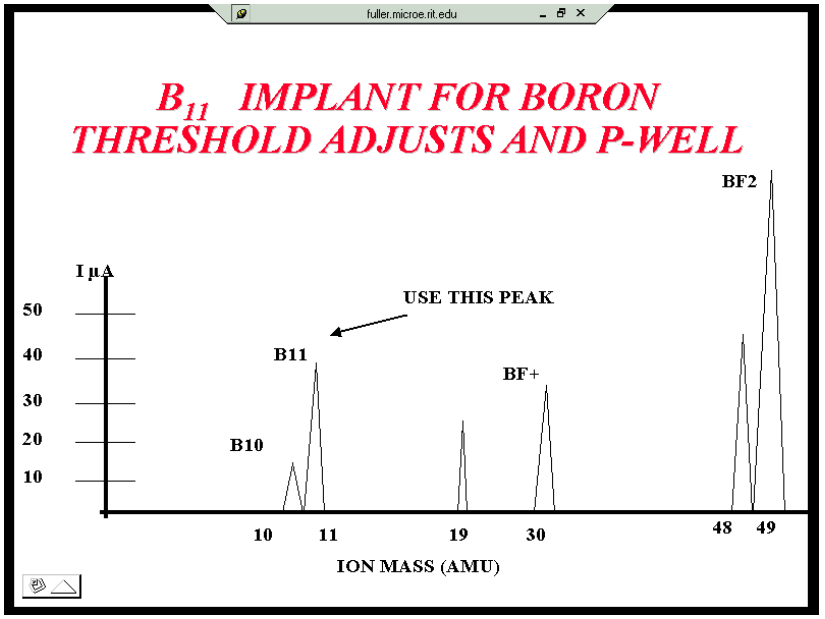
INSTRUCTION EXAMPLE

PrtScrn | Copy | Paste | Send | Recv | Display | Color | Map | Record | Stop | Play | Quit | Clipbrd | Support | Index

```
     9/09/07                              MESA                    IGMSINQ    S36801
     6:57:36                  Instruction Group Inquiry           QPADEV0019   RIT

Type information.  Then Enter.
  1=Display document, 5=Display detail

  Plant  . . . . . :   RIT
  Instruction group  . .   SUB-CMOS-IM01-P+-DS   SUB-CMOS IM01 P+ DS IMPLANT
    Revision . . . . . .   150

  Opt Subgroup  Text
   _            1.0 Include D1-D3 (see subi_pds)
   _            2.0 Ion Implant Boron, Gas = BF3, Species B11
   _            3.0 Dose = 4e15 (approx 15 min/wafer)
   _            4.0 Energy = 50 KeV (keep beam current below 250uA)
   _            5.0 Record Energy, Dose, Set-up time, Gas, Species



                                                                      Bottom
F3=Exit    F4=Prompt    F5=Refresh    F10=View 2    F12=Cancel

MA    a                                                          12/005
```

EXAMPLES OF GRAPHICAL DOCUMENTS





MESA PRODUCT DEFINITION

PRODUCT CLASS
(ANALOG, DIGITAL, MASK)

PRODUCT

GATE ARRAY

MASKSET
MASK ID'S
STEPPER JOB
MASK LEVEL NAMES

OPAMP

MASKSET
MASK ID'S
STEPPER JOB
MASK LEVEL NAMES

FILTER

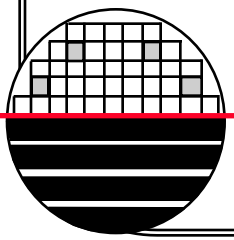
MASKSET
MASK ID'S
STEPPER JOB
MASK LEVEL NAMES

EEPROM

MASKSET
MASK ID'S
STEPPER JOB
MASK LEVEL NAMES

CCD'S

MASKSET
MASK ID'S
STEPPER JOB
MASK LEVEL NAMES



MASKS

PROCESS

↳ **MASK LEVEL NAMES**

MASK SET NAME (DEFINES THE PRODUCT)

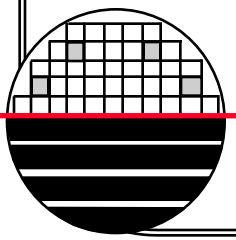
↳ **MASK ID'S**

EXAMPLE:

CMOS PROCESS

LEVEL NAMES:

CMOSWELL	**PRODUCT: GATE ARRAY**	
CMOSACTIVE	**MASKSET NAME:**	**E951FACLFX**
CMOSSTOP		**E951FACLF1**
CMOSVT		**E951FACLF2**
CMOSPOLY		**E951FACLF3**
CMOSN+DS		**E951FACLF4**
CMOSP+DS		**E951FACLF5**
CMOSCC		**E951FACLF6**
CMOSMETAL1		**E951FACLF7**
		E951FACLF8
		E951FACLF9



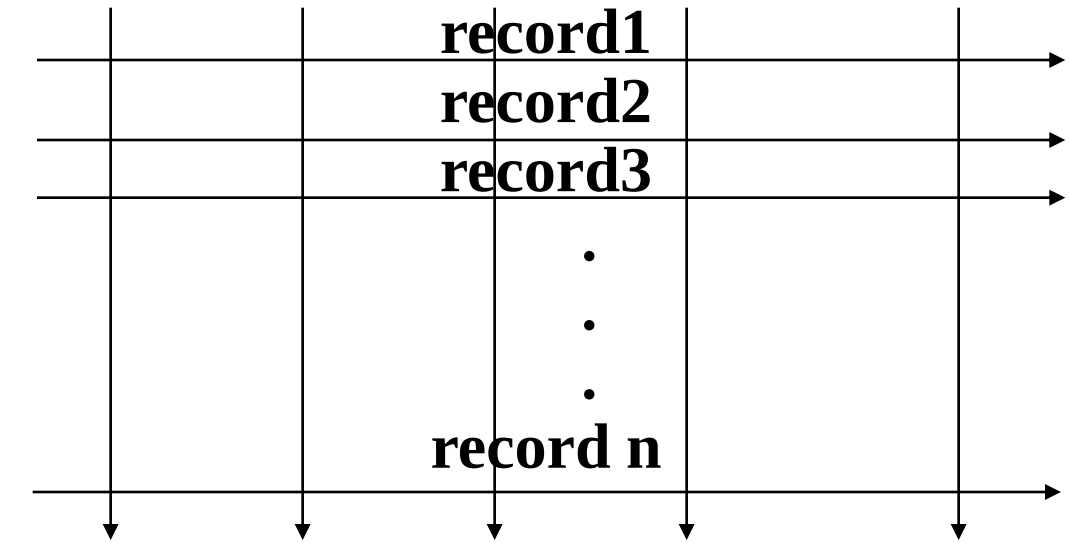
DATA BASE

LIBRARY

↓

TABLES/FORMATS

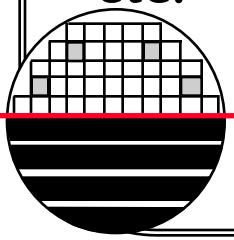
↓



TABLES (FILES)

In the Mesa Database Library (MESADB) there are over 200 File names (TABLES) with descriptions such as:

LTLLH100 Lot History
LTLMD101 MESA Move Detail/UDC x Lot/Oper/Step/Date/Time
LTLMD103 MESA Move Detail/UDC x Oper/Date/Time
LTPMD100 MESA Move Detail
LTPMS100 MESA Maskset Name
LTLLG102 MESA Lot Genealogy by transaction date/time
LTLLT105 MESA Lot Master x Original Lot/Start date
etc.

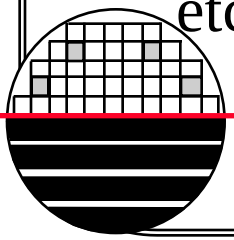


FIELD NAMES (COLUMNS) & RECORDS (ROWS)

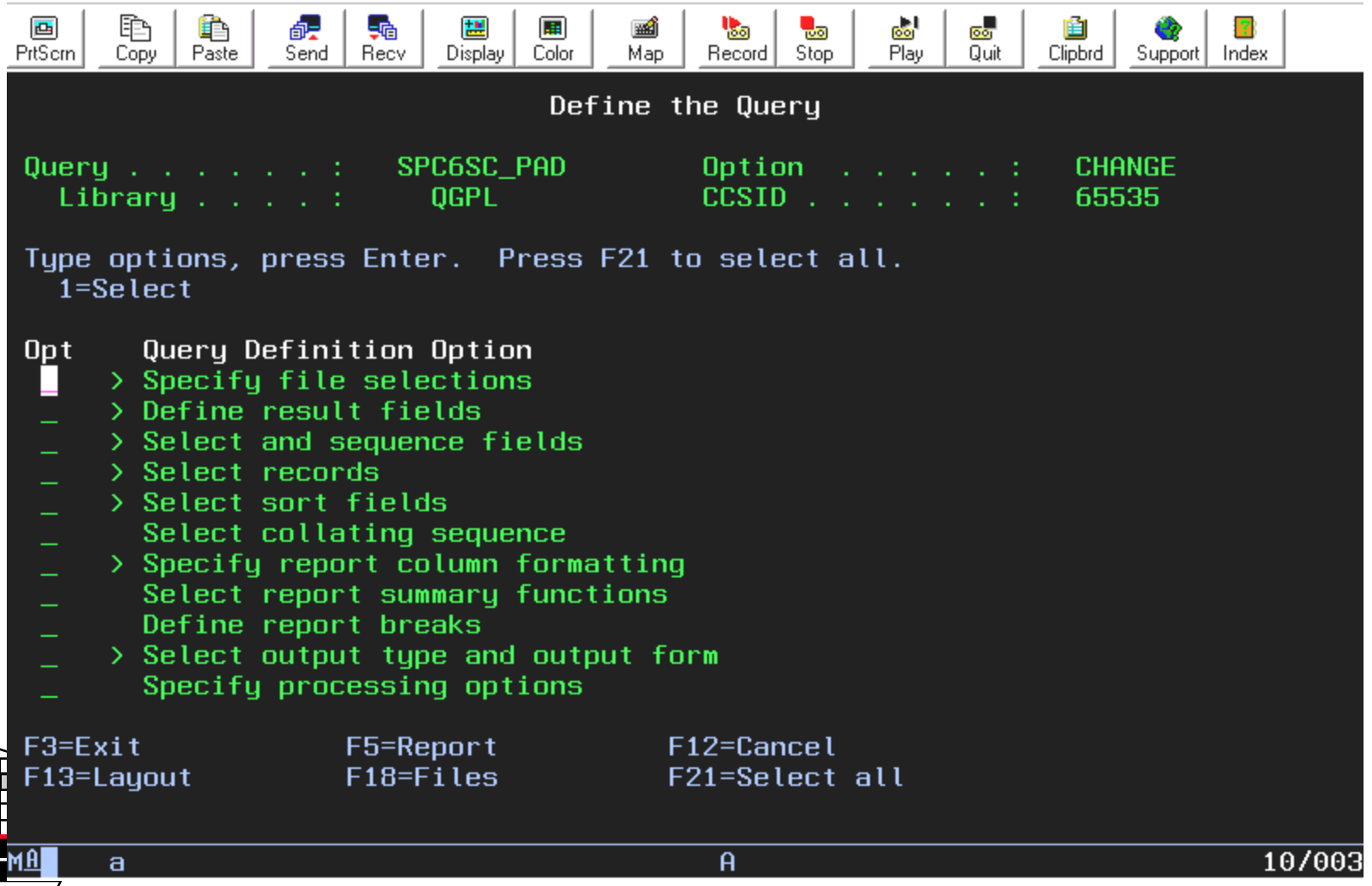
Each file has fields (columns) defined for storage of data in a record (row). In the LTPMD100 file called MESA Move Detail there are about 70 fields. Some are listed below:

MDTRCD	Transaction Code
MDLOT	Lot Number
MDTRYR	Transaction Year
MDUSER	User ID
MDTOOP	To operation
MDFSTP	From process step
MDUD1	User defined field 1
MDPRC	Process

etc



QUERY PROCESSING

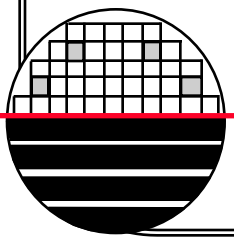


FILE SELECTIONS

File =	LTLMD101
Library =	MESADB
Member =	*FIRST
Format =	LTFMD101

MESA has over 200 File names with descriptions such as:
LTLLH100 Lot History File
LTLMD101 MESA Move Detail/UDC x Lot/Oper/Step/Date/Time
LTLMD103 MESA Move Detail/UDC x Oper/Date/Time
LTPMD100 MESA Move Detail
LTPMS100 MESA Maskset Name File

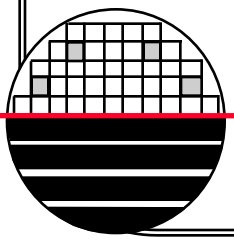
These files can be joined in various ways



DEFINE RESULTS FIELDS

Field	Expression	Column	Len	Dec
DATE	MDTRYR*10000 + MDTRMO *100 + MDTRDY		6	0

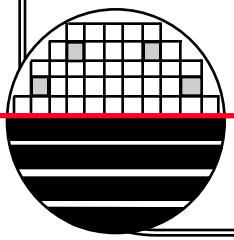
the number DATE is defined in terms of Mesa Database value for Transaction Year (MDTRYR), Mesa Database value for Transaction Month and Mesa Database value for Transaction Day. This value will be easy to perform functions on such as equal, greater than, less than, etc.



DEFINE RESULTS FIELDS

Field	Expression	Column	Len	Dec
DATE	**(MDTRCT+19)*1000000+MDTRYR*10000 + MDTRMO *100 + MDTRDY**	8	0	

the number DATE is defined in terms of Mesa Database value for Transaction Century (MDTRCT) Year (MDTRYR), Mesa database value for Transaction Month and Mesa Database value for Transaction Day. Example: December 8, 2012 will have date value of 20121208. This value will be easy to perform functions on such as equal, greater than, less than, etc.

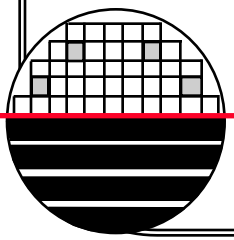


SELECT FIELDS

Order	Code	Description	Len	Dec
10	MDFSTP	Mesa Database From Step	6	2
20	MDFROP	Mesa Database From Operation	4	0
30	DATE	DATE as defined	6	0
40	MDLOT	Mesa Database Lot Number	10	0
50	COUNT1	UDN01*	6	0
60	COUNT2	UDN02*	6	0
70	XOX	UDN03*	4	0
80	PADOX	UDN03*	4	0

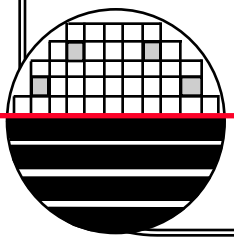
etc.

* user defined numeric parameter 01, 02, etc up to 18



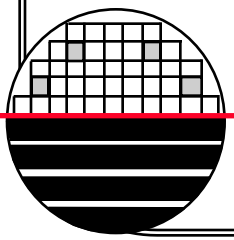
SELECT RECORDS

	MDFSTP	LIST	4, 3, 44, 12, 13, 17, 22 14, 20, 30, 41, 50, 56
AND	MDPRC	EQ	CMOS
AND	MDMVTP	EQ	1
AND	MDFROP	LIST	CL01, OX04, OX05, PH03, CV02
AND	MDLOT	GT	F950000
AND	MDLOT	LT	F980000



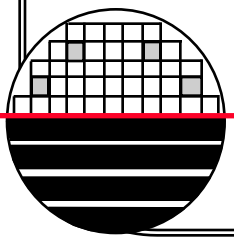
SELECT SORT FIELDS

PRIORITY	A/D	
10	A	MDFSTP
20	A	DATE
30	D	MDLOT



OTHER

> Select collating sequence
(Ascending, Descending)
> Specify report column formatting
(Column Heading, Number of characters, etc.)
> Select report summary functions
(Total, Average, Minimum, Maximum, Count)
> Define report breaks
(new page after each sort field, etc)
> Select output type and output form
(printed, to display, etc.)
> Specify processing options
(batch, interactive, ...)



EMPLOYEE MOVES EXAMPLE

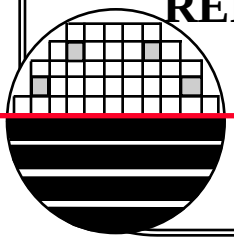
QUERY DEFINITION FOR AS/400
QUERY NAME: EMPLOYEE **LIBRARY:** MESADB
FILE: LTLMD101 **FORMAT:** LTFMD101
RESULT FIELDS:
SELECT RECORDS:

	MDLOT	LIKE	'F%'	
AND	MDMVTP	EQ	'1'	
AND	MDTRTM	GT	8	
AND	MDTRYR	GT	98	
AND	MDEMP	LIST	'LFFEEE'	'KDHEMC' 'KEBEMC'

ORDERING OF SELECTED FIELDS:
REPORT COLUMN FORMATTING AND SUMMARY FUNCTIONS

MDTRYR	1=TOTAL
MDTRMO	2=AVE
MDTRDY	3=MIN
MDFROP	4=MAX
	5=COUNT

REPORT COLUMN FORMATTING AND SUMMARY FUNCTIONS:
REPORT BREAKS:



QUERY DEFINITION TO FIND SETUP AND RUN TIMES FOR ALL FACTORY OPERATIONS

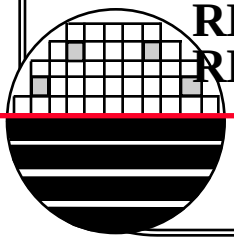
QUERY DEFINITION FOR AS/400
QUERY NAME: ASSESSMENT **LIBRARY:**MESADB
FILE: LTLMD101 **FORMAT:**LTFMD101
RESULT FIELDS: SETUPTIME UDN04
SELECT RECORDS: MDLOT LIKE 'F%'

AND	MDMVTP	EQ	'1'
AND	MDTRTM	GT	4
AND	MDTRYR	GT	98
OR	MDLOT LIKE	'F%'	
AND	MDTRYR	GT	98
AND	MDFROP	EQ	'IM01'

ORDERING OF SELECTED FIELDS:
REPORT COLUMN FORMATTING AND SUMMARY FUNCTIONS

MDTRYR		1=TOTAL
MDTRMO		2=AVE
MDTRDY		3=MIN
MDFROP	5	4=MAX
MDRTM	2 3 4	5=COUNT
SETUPTIME	2 3 4	

REPORT COLUMN FORMATTING AND SUMMARY FUNCTIONS:
REPORT BREAKS:



QUERY DEFINITION FOR CMOS PROCESS DATA

QUERY DEFINITION FOR AS/400
QUERY NAME: CMOSPART1 **LIBRARY:**MESADB
FILE: LTLMD101 **FORMAT:**LTFMD101
RESULT FIELDS: DATE
MDTRYR*10000+MDTRMO*100+MDTRDY
SELECT RECORDS:

	MDLOT	LIKE	'F%'
AND	MDMVTP	EQ	'1'
AND	MDTRTM	GT	4
AND	MDTRYR	GT	98
OR	MDLOT	LIKE	'F%'
AND	MDTRYR	GT	98
AND	MDFROP	EQ	'IM01'

ORDERING OF SELECTED FIELDS:
REPORT COLUMN FORMATTING AND SUMMARY FUNCTIONS

MDTRYR		1=TOTAL
MDTRMO		2=AVE
MDTRDY		3=MIN
MDFROP	5	4=MAX
MDRTM	2 3 4	5=COUNT
SETUPTIME	2 3 4	

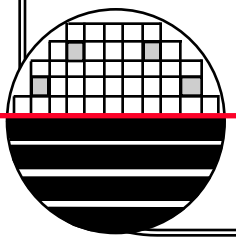
REPORT COLUMN FORMATTING AND SUMMARY FUNCTIONS:
REPORT BREAKS:

DATA

DATA UP TO 9-15-97												
Parameter Name	Units											
Alignment Oxide	Å	6900	4846	4941	4097	4282	5243	4035	5449	4928	4505	4905
Pad Oxide	Å	511	530	594	481	514	500	490	365	479	484	522
Nitride Thickness	Å	1535	1570	1850	1850	1690	1737					
Field Oxide Thicknes	Å	10874	9660	10443	10489	9546	10711	10743	11651	9455	11357	10987
Photo x-overlay	µm	2	1	1	2	1	2	-1	1	-1	0	0
Photo y-overlay	µm	1	1	1	0	2	0	1	-1	-1	-1	0
Kooi Oxide Thicknes	Å	804	399	750	902	814	717	230	1056	981	1200	869
Gate Oxide	Å	601	494	503	484	443	430	503	495	499	508	496
Poly Thickness	Å	5723	6272	6635	6652	6442	7185	6089	4383	5656	4607	5107
Poly Sheet Rho	Å	24	32	18	27	72	55	16	15	22	32	15
LTO Thickness	Å	4570	2282	3166	4913	3724	7356	5318	4616	6700	4479	3386
Metal Thickness	Å	4000	5000	4000	2300	6500	7500					
Rho N+	ohms	21	22	28	27	24	33	17	24	25	22	20
Rho P+	ohms	44	91	36	70	54	28	25	25	35	26	23
Rho Well	ohms	973	1380	1250	1020	1360	1500	1260	2290			
Rho Metal	ohms	0.06	0.09	0.05	0.01	0.15	0.14	0.1	0.11	0.16		
Gc met-Poly	mho/µm2	0.03	0.02	0.023								

REPORTS

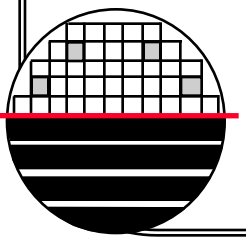
TLOGRPT Transaction Log Report
PSRTMNU Production Summary Report Menu
    PSBORPT Production Analysis
LSRTMNU Lot Status Report Menu
    LSHPRPT Lot Ship Summary Report
    LSTRRPT Lot Start Summary Report



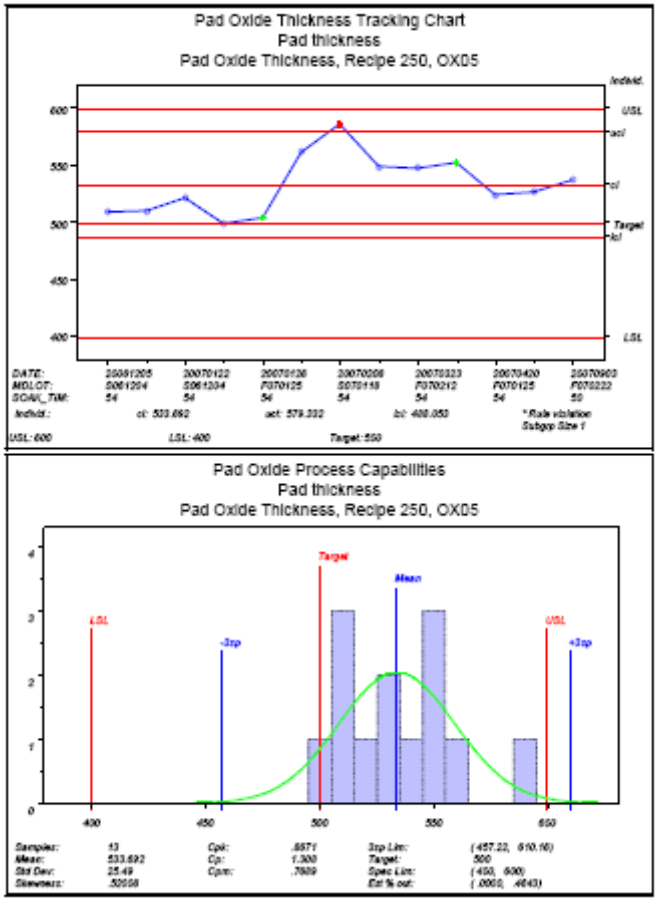
STATISTICAL PROCESS CONTROL CHARTS

1. All Processes - RCA Clean Particle Delta
2. PMOS/CMOS - 5000 A Wet Oxide Thickness
3. P-well CMOS - Well Drive-in Oxide Thickness
4. P-well CMOS - Well Drive-in Rhos
5. P-well CMOS - Well Drive-in Junction Depth
6. NMOS/CMOS - Pad Oxide Thickness
7. All Processes - Field Oxide Thickness
8. NMOS/CMOS - Kooi Oxide Thickness
9. All Processes - Gate Oxide Thickness
10. NMOS/CMOS - Nitride Deposition Thickness
11. NMOS/CMOS - Polysilicon Deposition Thickness
12. NMOS/CMOS - Polysilicon Rhos
13. NMOS/CMOS - Polysilicon Etch Rate
14. NMOS/CMOS - Nitride Etch Rate
15. P-well CMOS - N+ Rhos
16. P-well CMOS - N+ Xj
17. P-well CMOS - P+ Rhos
18. P-well CMOS - P+ Xj
19. All Processes - Metal Thickness
20. P-well CMOS - 4 um CD
21. P-well CMOS - X&Y Overlay

99. All Query Update - may take 1 hour



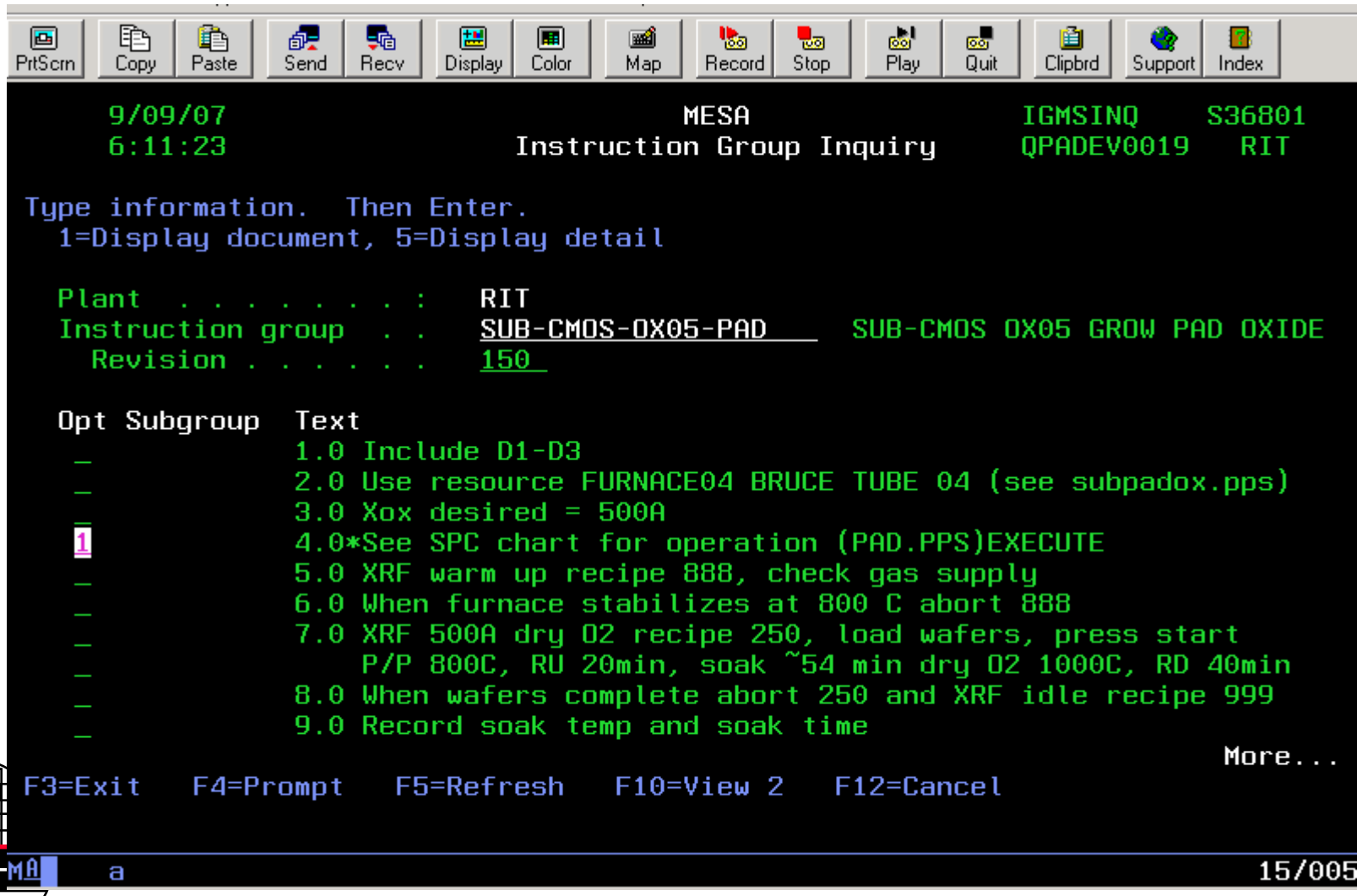
SPC CHARTS



Statistical Process Control Charts (SPC Charts) combine a query with data analysis and plotting software.

North West Quality Analysis software is used at RIT to display the SPC Charts. We display a run chart (top), Histogram (bottom), Gaussian Model (Green), and Calculations of Mean, Standard Deviation, Cpk, Cp and other statistical parameters.

SPC CHARTS CAN BE VIEWED AT MOVE-IN

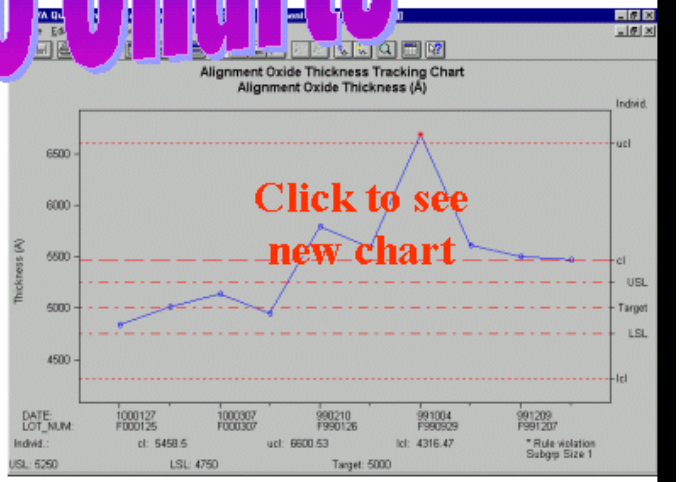


SPC MAIN MENU

fuller.microe.rit.edu

EXIT

Pad Oxide SPC Charts



Process Out of Control If:

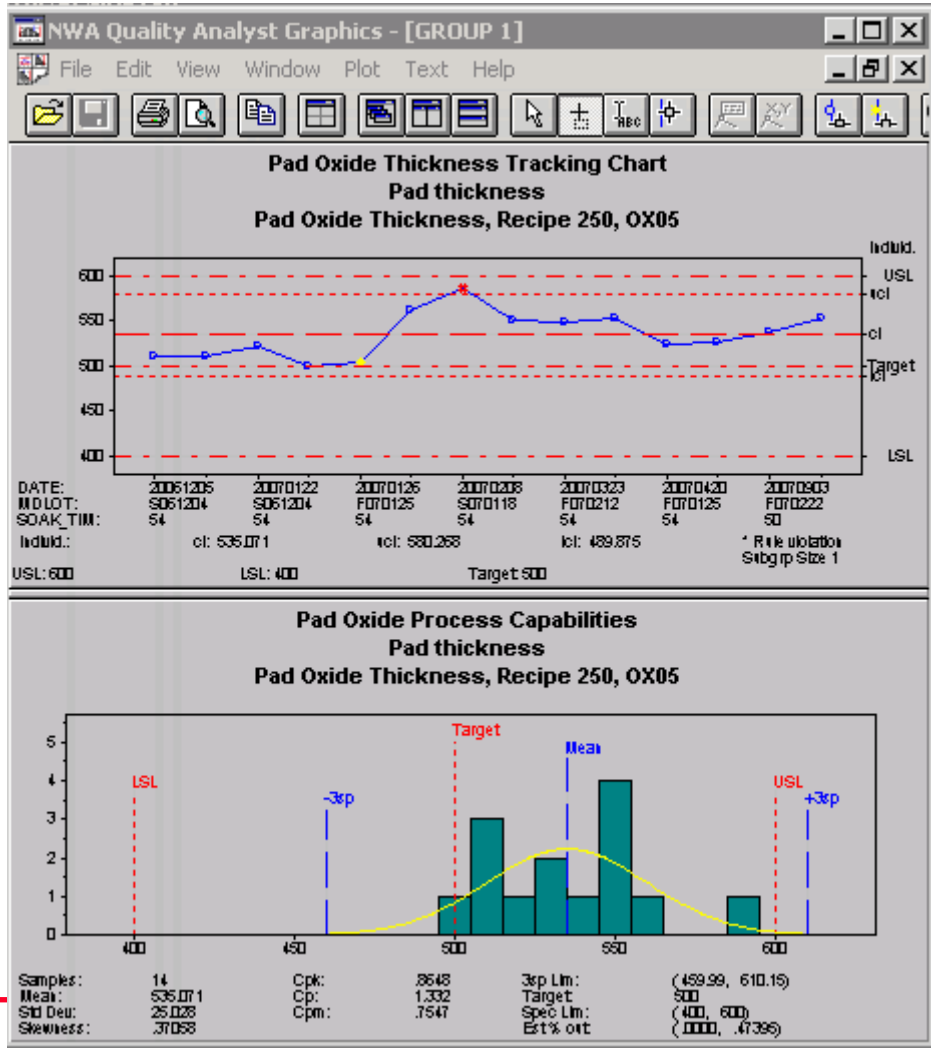
- any point outside the spec limits (i.e. a single point above or below 3 sigma)
- a run of 6 or more points increasing or decreasing
- a run of 5 or more points above/below the target
- 2 of 3 points above/below 2 sigma

If process is out of control initiate the out of control action plan

Click to see Action Plan

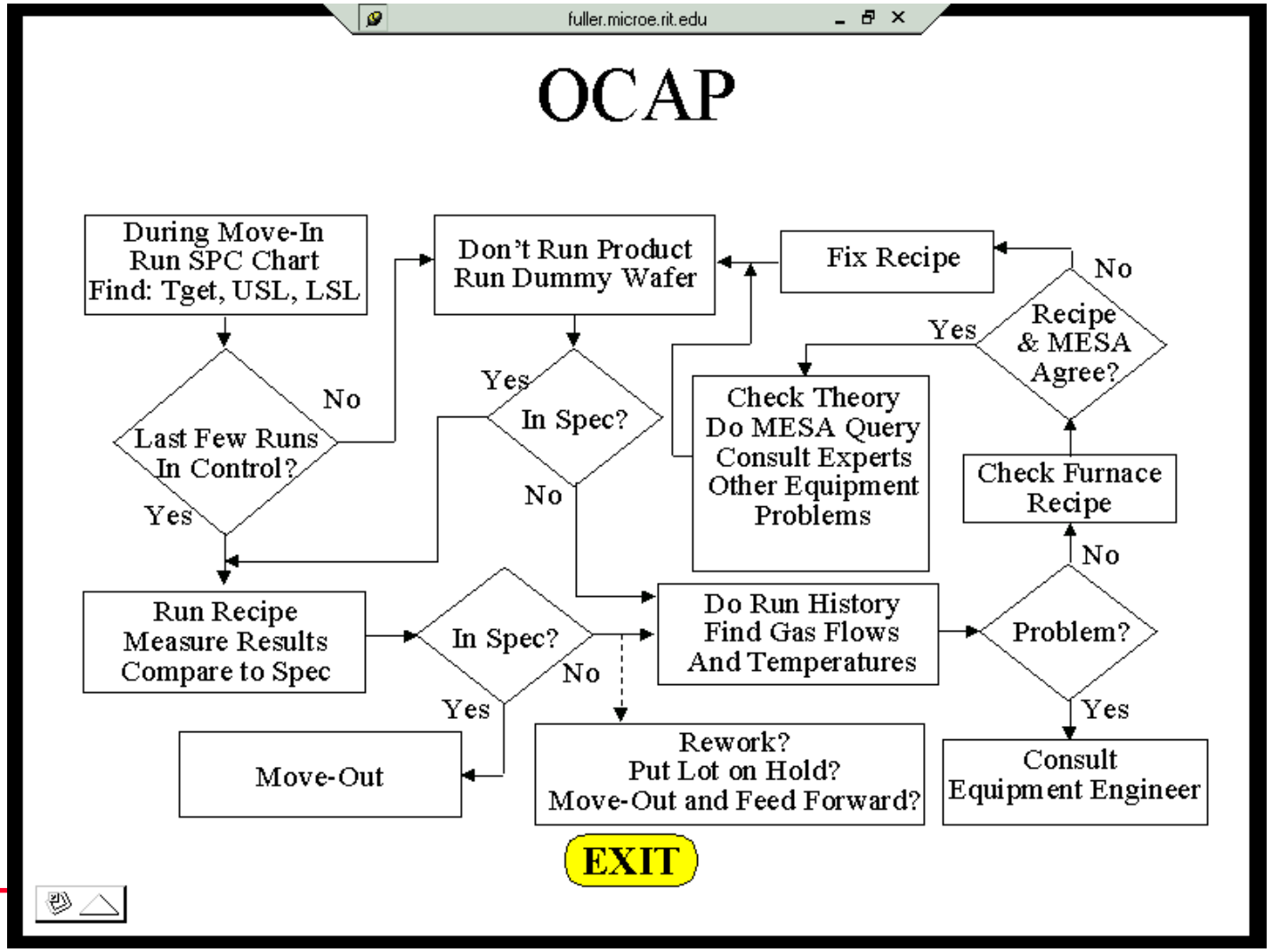
More Questions? Click Me

NWA QUALITY ANALYST, SPC CHART



Pad Oxide
Target 500Å
USL 600Å
LSL 400Å
Mean 535Å
Std Dev 35Å
Cpk 0.8648
Cp 1.332

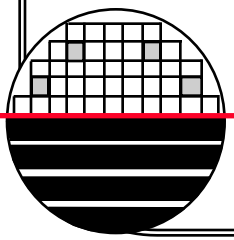
OUT OF CONTROL ACTION PLAN



REFERENCES

1. "MESA System Overview", Camstar Systems, Inc., 2105 South Bascom Avenue, Suite 200, Campbell, California 95008, Tel: (408) 59-5700, Fax: (408) 559-5719.

2. "AS/400 Query (Program 5728-QU1), Relese3, Modification 0" , IBM Corporation, Department 245, 3605 North Highway 52, Rochester, MN 55901-9986.



HOMEWORK – INTRO TO MESA

1. **What are the components of a process definition?**
2. **How is a product defined?**
3. **Give an example of a data base query?**
4. **What does MESA allow an Engineer to do that an Operator can not do?**
5. **Give a brief description of the following terms as they relate to the RIT Factory and CIM system. Give an example where it makes sense. Show a schematic diagram to illustrate hierarchical relationships for related items.**

AS/400, Ethernet, Exit F3, Cancel F12, User ID, Operator, Integrated Relational Database, Resource, Work Center, Operation, Department, Plant, Resource Type, Resource Sub Type, Resource ID, Unit of Measure, User Defined Units of Measure, Start Code, Scrap Code, Bonus Code, Yield Loss Code, Hold Code, Operation, Process, Specification, Product, Product Class, Mask ID, Mask Level Names, Mask Set, Document, Step, Instruction Group, Parameter Group, Report, Listing, Inquiry, Query, Transaction