Process Improvement Project: SMFL Control Charts

May 26th, 2006

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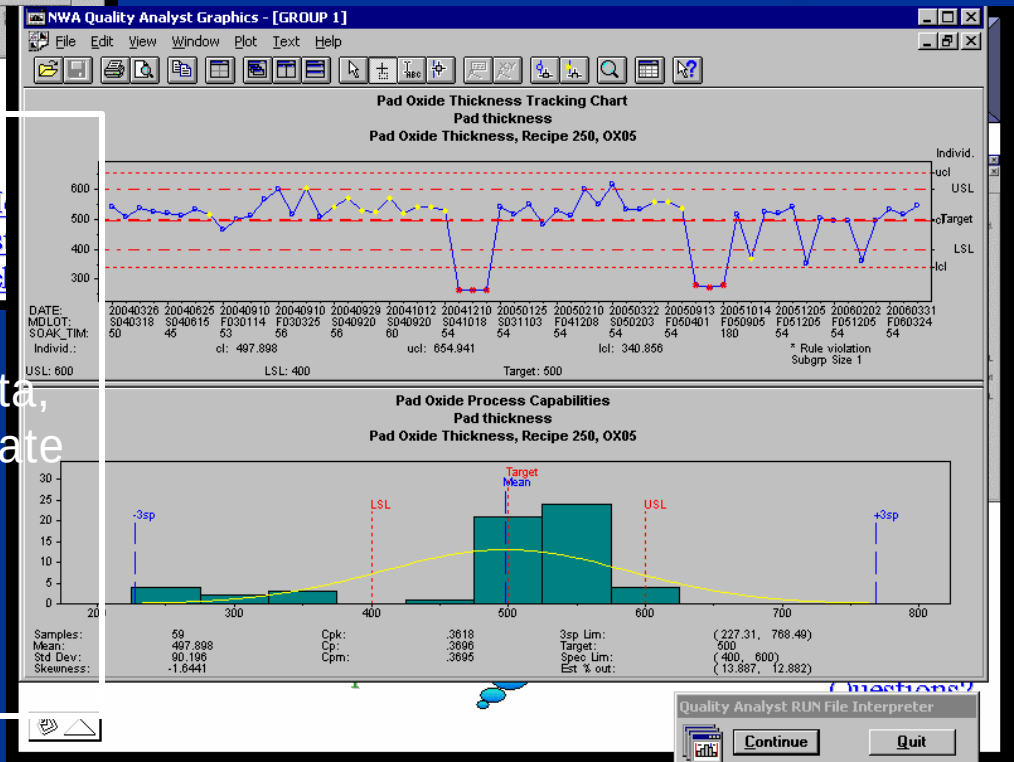
Outline

- Project Overview
- Process Map
- Setting Specification Limits
- Future Needs

Project Overview

Make these sheets work!



query

3. Query should look up the correct data, combining processes when appropriate
4. Target, USL, LSL should be set appropriately

Process Map

Click on each item to view details….

What is Complete?

SPC Queries in MESA	Operation
SPC6SC_PAD	Pad Oxide
SPC6SC_CNT	Particle Count for Step 3
SPC6SC_FO	Field Oxide
SPC6SC_GOX	Gate Oxide
SPC6SC_KOX	KOOI Oxide
SPC6SC_LTO	Low Temperature Oxide
SPC6SC_MTL	Metal 1
SPC6SC_NI1	1500 A Nitride
SPC6SC_NI2	3500 A Nitride
SPC6SC_NRS	Test Measurement
SPC6SC_POL	Poly
SPC6SC_PRS	Test Measurement
SPC6SC_WO	Well Oxide
SPC6SC_WRS	Test Measurement
SPC6SC_2CD	2um CD Line Width
SPC6SC_350	Well Oxide?
SPC6SCPORS	DE01?

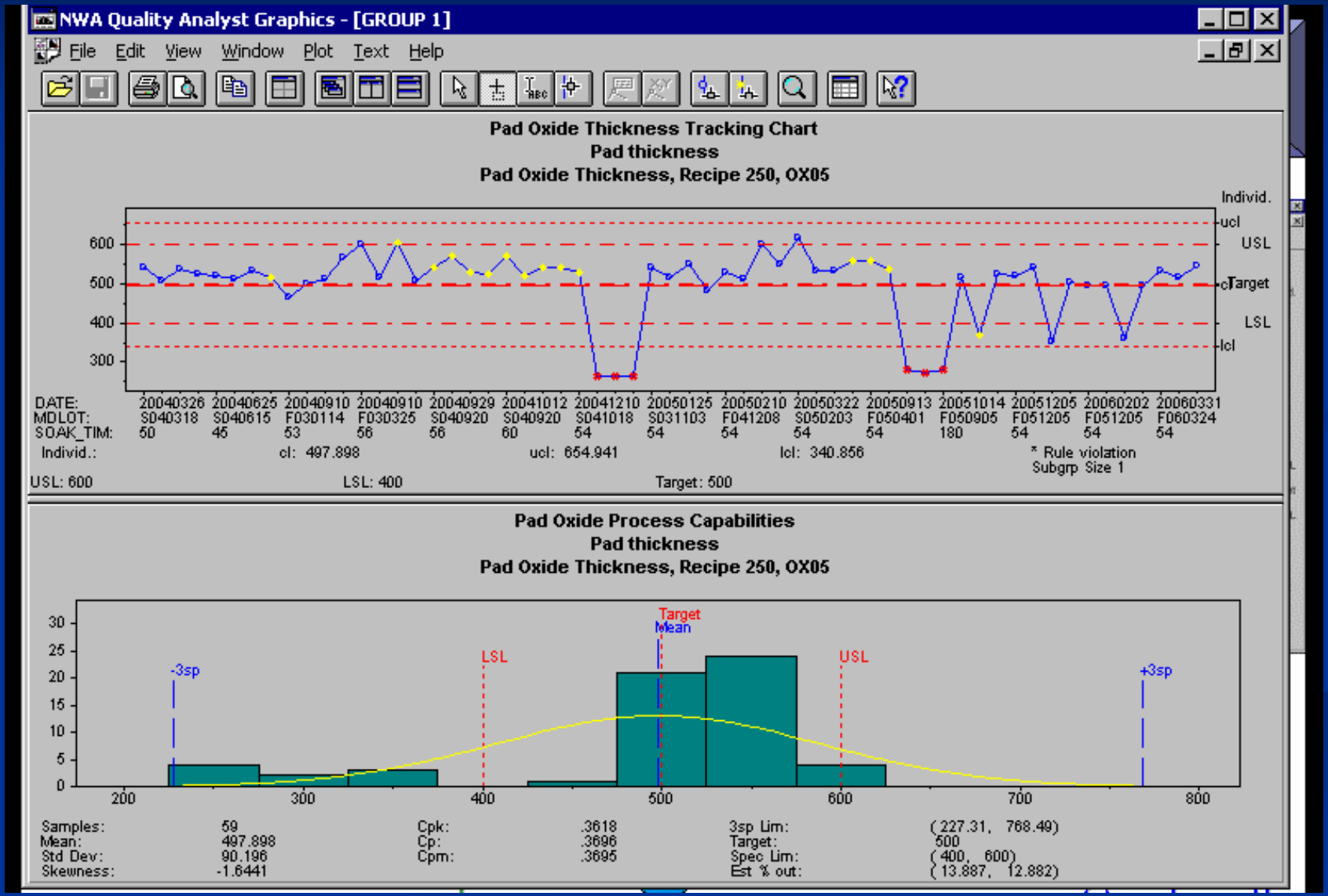
What is Complete?

Process	Product	Step #	Recipe Desc	Required Action	Query Name in Mesa	Query Save Location	Power Point and Run File Location	Powerpoint Name	Document Name in MESA
PAD OXIDE	SMFL-CMOS	4, 16	500A oxide--OX05	Make all 7 steps use the same control chart	SPC6SC_PAD	QGPL.SC6PAD	J:\QA\SCMOS150	pad.pps	SPC6SCPAD
	SUB-CMOS 150	4, 17	500A oxide--OX05		SPC6SC_PAD	QGPL.SC6PAD	J:\QA\SCMOS150	pad.pps	SPC6SCPAD
	ADV-CMOS 150	4,10,39	500A oxide--OX05		SPC6SC_PAD	QGPL.SC6PAD	J:\QA\SCMOS150	pad.pps	SPC6SCPAD
PARTICLE COUNT	SMFL-CMOS	3	particle count	Make all 3 products use the same control chart	SPC6SC_CNT	QGPL.PTCL_SC6	J:\QA\SCMOS150	ptcl.pps	SPC6SCPTCL
	SUB-CMOS 150	3	particle count		SPC6SC_CNT	QGPL.PTCL_SC6	J:\QA\SCMOS150	ptcl.pps	SPC6SCPTCL
	ADV-CMOS 150	3	particle count		SPC6SC_CNT	QGPL.PTCL_SC6	J:\QA\SCMOS150	ptcl.pps	SPC6SCPTCL
FIELD OXIDE GROWTH	SMFL-CMOS	25	163, 5hr Soak 950C	Make separate query and control chart for each product	SPC_FIELDO	QGPL.FIELDOX	J:\QA	FIELD_OX.pps	SPC_FIELD_OX
	SUB-CMOS 150	26	406, 65min Soak 1100C		SPC6SC_FO	QGPL.SC6FLDOX	J:\QA\SCMOS150	FIELDOX.pps	SPC6SCFIELDOX
	ADV-CMOS 150	---	---		---	---	---	---	---
GATE OXIDE	SMFL-CMOS	35	474, 310A--OX06	Each product needs its own chart b/c unique recipes	SPC_GATEOX	GATE_OX	J:\QA	Gate_ox.pps	SPC6SCGATEOX
	SUB-CMOS 150	35	215, 150A--OX06		SPC6SC_GOX	SC6GATEOX	J:\QA\SCMOS150	gateox.pps	SPC_GATE_OX
	ADV-CMOS 150	33	213, 100A--OX06		SPCADV_GOX	SPCADVGOX	J:\QA\ADVCMOS	gate_ox.pps	SPCADVGOX
KOOI OXIDE	SMFL-CMOS	28	311, 40 min wet O2 900C	Add SMFL-CMOS to Sub-CMOS Query	SPC6SC_KOX	SC6KOOIOX	J:\QA\SCMOS150	KOOIox	SPC6SCKOOI
	SUB-CMOS 150	29	311, 40 min wet O2 900C		SPC6SC_KOX	SC6KOOIOX	J:\QA\SCMOS150	KOOIox	SPC6SCKOOI
	ADV-CMOS 150	---	---		---	---	---	---	---
LTO	SMFL-CMOS	51, 61	A6-FAC 0.4 TEOS	SMFL-CMOS needs SPC in Instrs for both steps. SUB-CMOS needs SPC in Instrs for step 50. SMFL, SUB, and ADV step 62 can all be combined into one SPC. ADV CMOS step 18 needs its own SPC.	SPC6SCLTO	SC6CLTOX	J:\QA\SCMOS150	LTO.pps	SPC6SCLTO
	SUB-CMOS 150	50, 61	A6-FAC 0.4 TEOS		SPC6SCLTO	SC6CLTOX	J:\QA\SCMOS150	LTO.pps	SPC6SCLTO
	ADV-CMOS 150	62	A6-FAC 0.4 TEOS		SPC6SCLTO	SC6CLTOX	J:\QA\SCMOS150	LTO.pps	SPC6SCLTO
	ADV-CMOS 150	18	A6-FAC 0.6 TEOS		SPCADV_LTO	SC6ADVLTO	J:\QA\ADVCMOS	LTO.pps	SPCADVLTO

Setting Spec / Control Limits

- Specification Limits:
  - USL: The largest value acceptable where the device will still work.
  - LSL: The smallest value acceptable where the device will still work.
- Control Limits:
  - UCL: Upper limit, that when exceeded indicates the process is out of control.
  - LCL: Lower limit, that when exceeded indicates the process is out of control.

Setting Spec / Control Limits



Setting Spec / Control Limits

- Specifications Limits are set by engineers
  - Dependent on the process requirements
    - ie. Minimum oxide thickness required to mask an implant
  - Discussions and simulations can help to decide
- Control Limits are a result of the process itself
  - Control limits are usually 3 sigma from the target
  - Ideally your control limits should be within your specification limits.

Future Needs

- Finish updating the remaining control charts
- Avoid using Step # in queries because adding or deleting steps from a process requires the queries to be updated.
  - Replace Step # with unique operation names
- Set specifications limits with more thought

Edit/Create Query

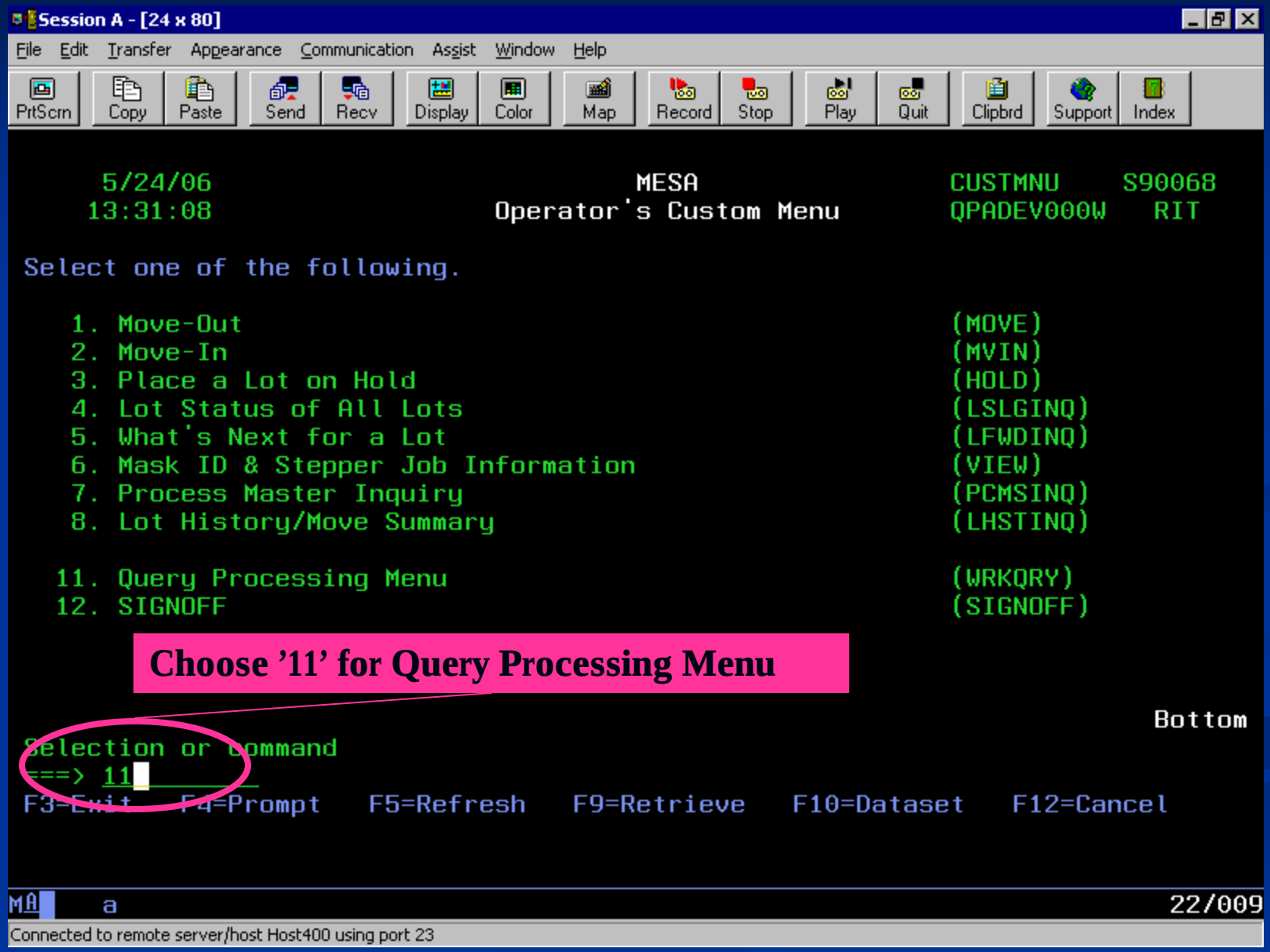
1. Decide what process steps to include in your query:
    1. Include all steps for all processes that use the same recipe
    2. PAD OXIDE EXAMPLE:

PROCESS	Step #	Recipe
SMFL-CMOS	4, 16	250
SUB-CMOS 150	4, 17	250
ADV-CMOS 150	4, 10, 39	250

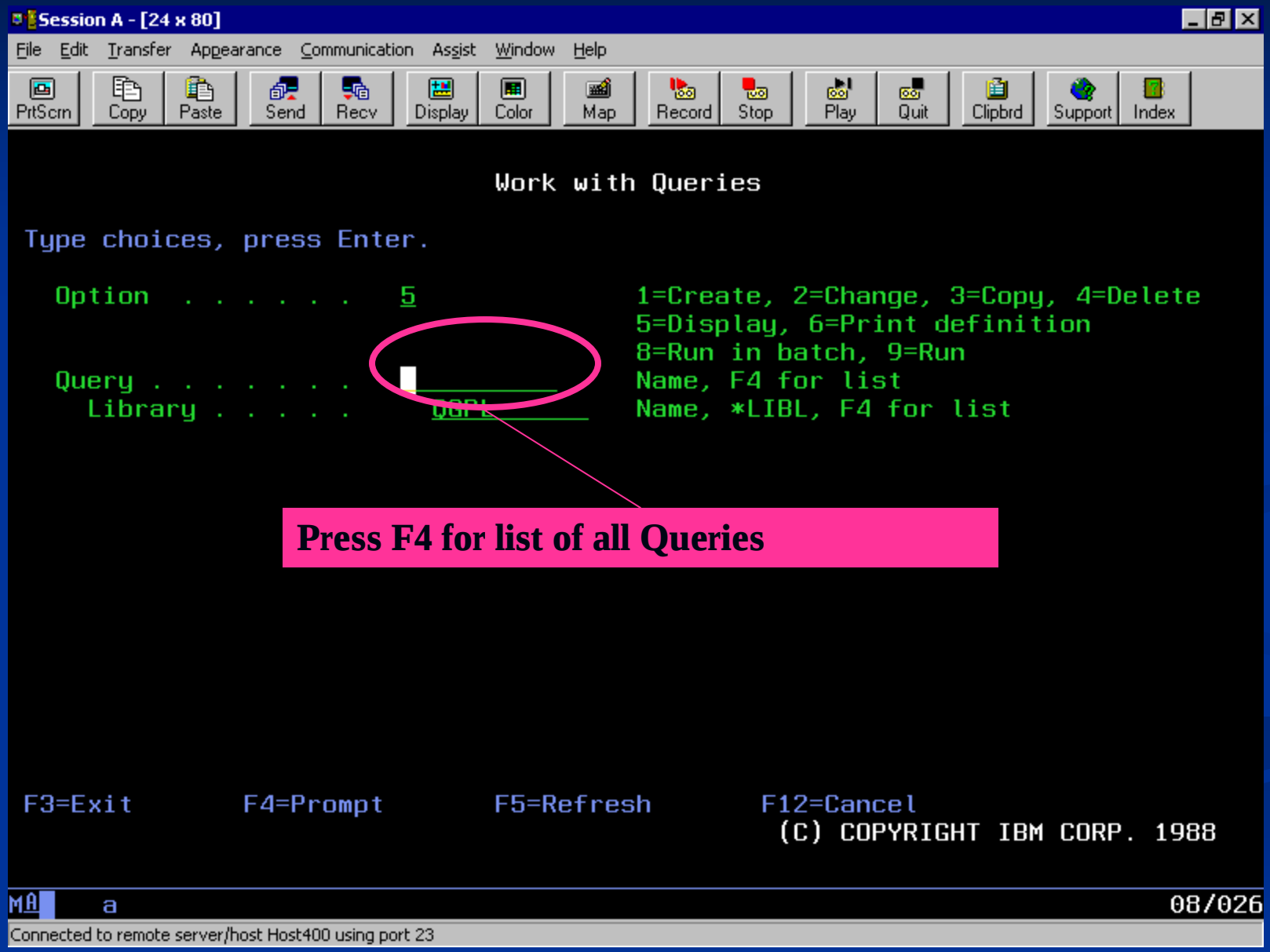
2. Compare your needs to the current query:
    1. Make changes to the existing query if necessary

(See next slides for how to access the queries)

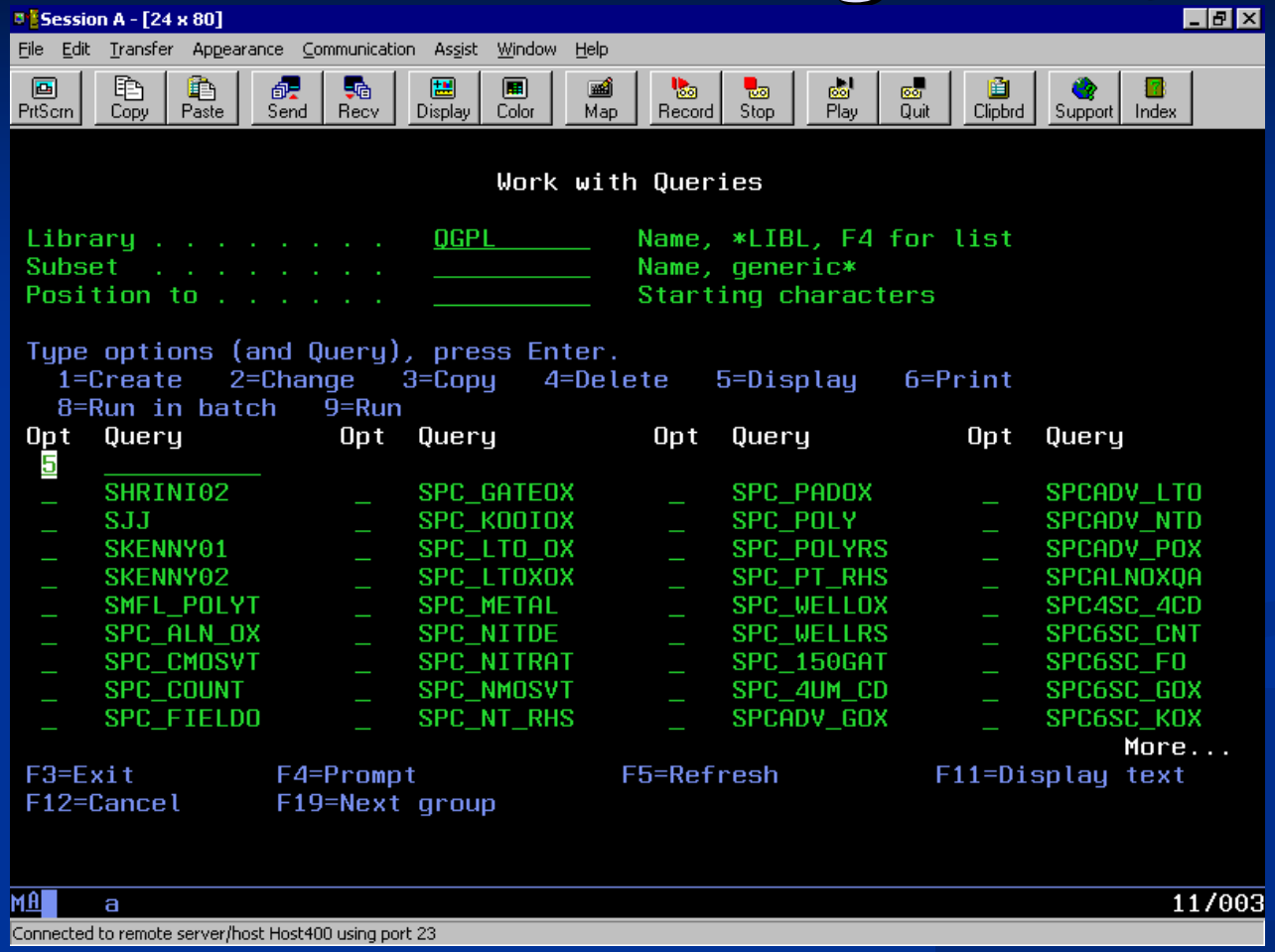
Accessing the Queries



Accessing the Queries



Accessing the Queries



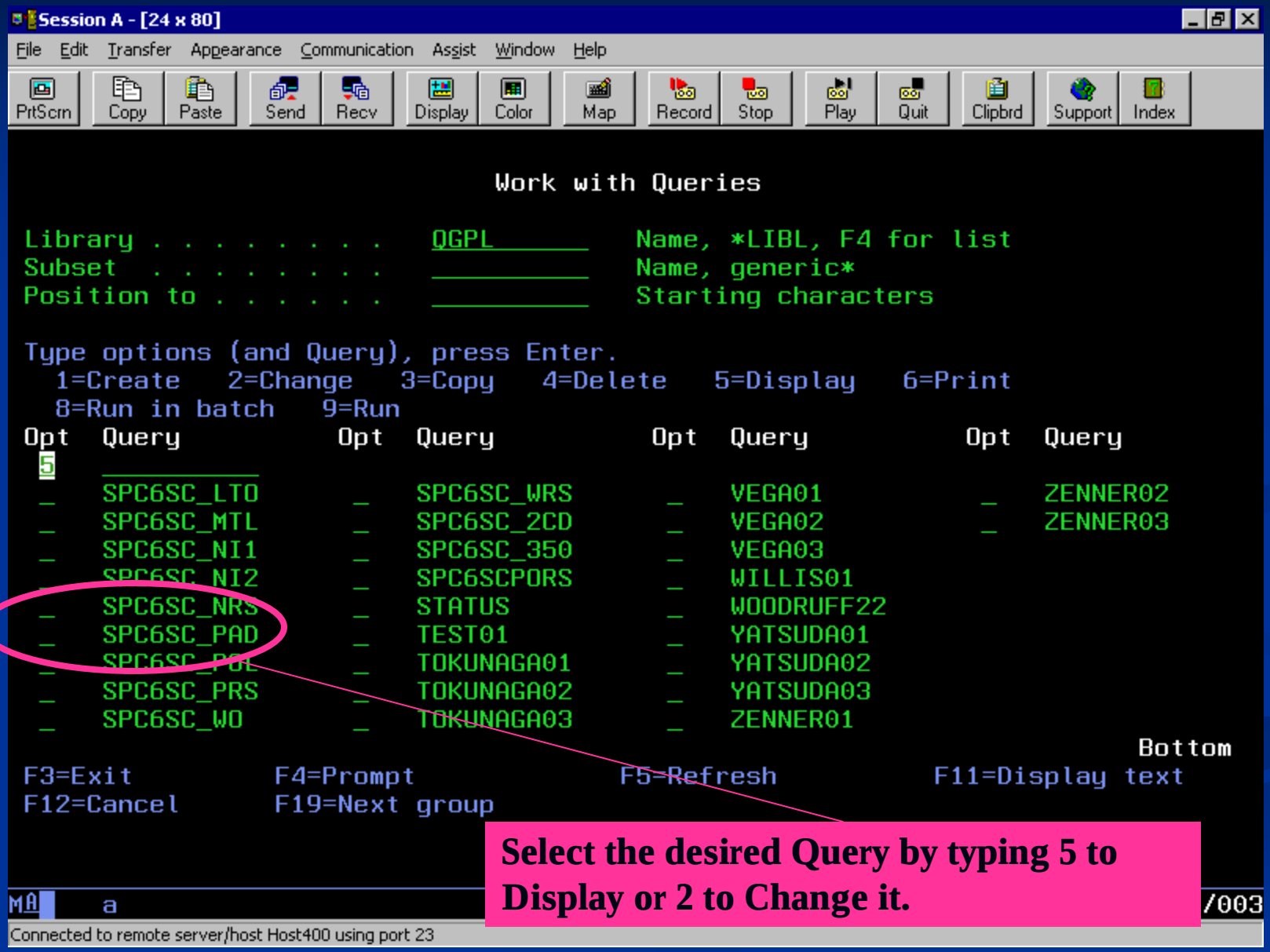
Page Down through the list of queries until you reach queries starting with SPC:

SPC_ are used for unique SMFL- CMOS

SPC6SC_ are used for SUB-CMOS and all processes with identical operations

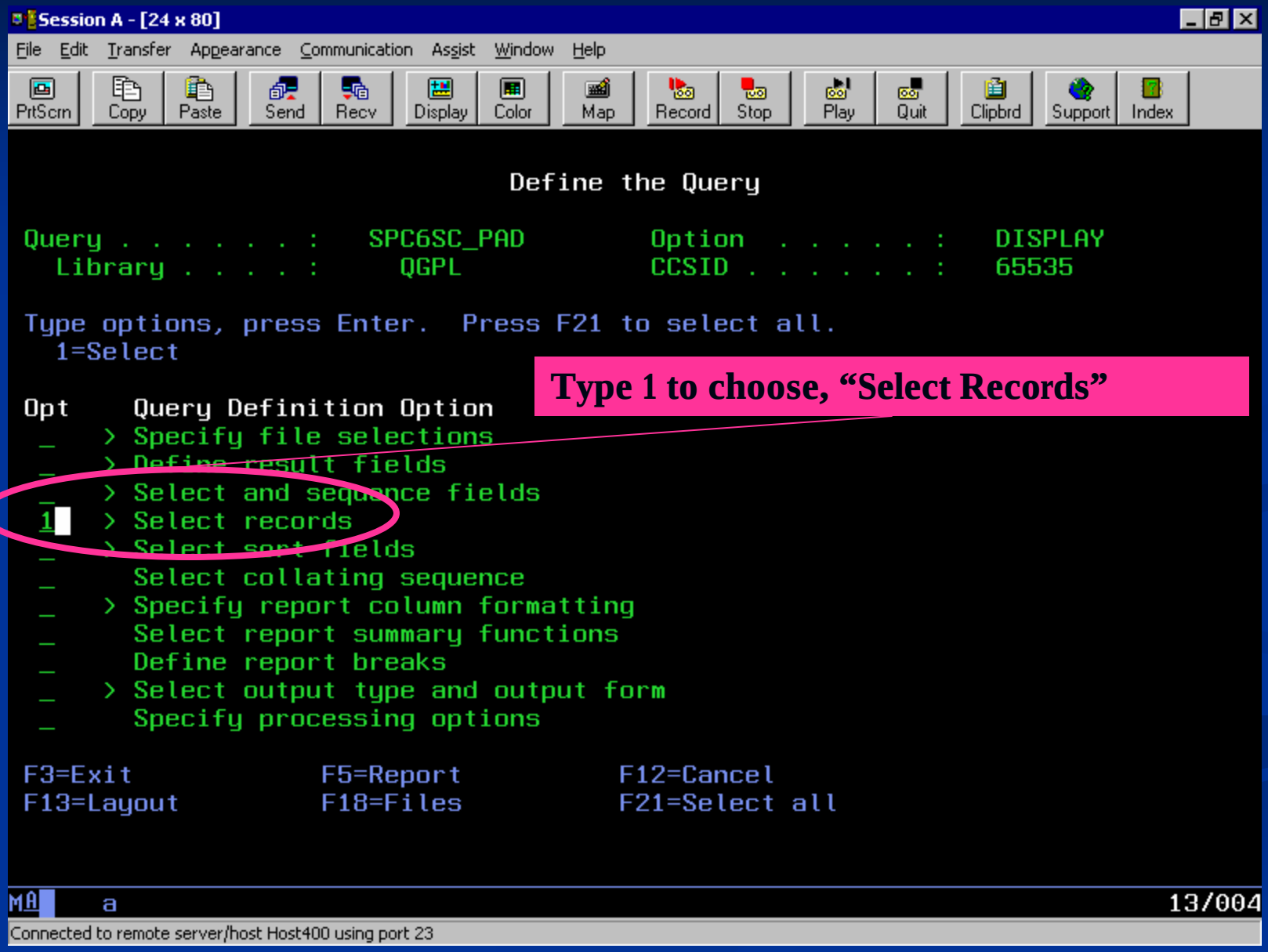
SPCADV_ are used for unique ADV-CMOS processes

Accessing the Queries



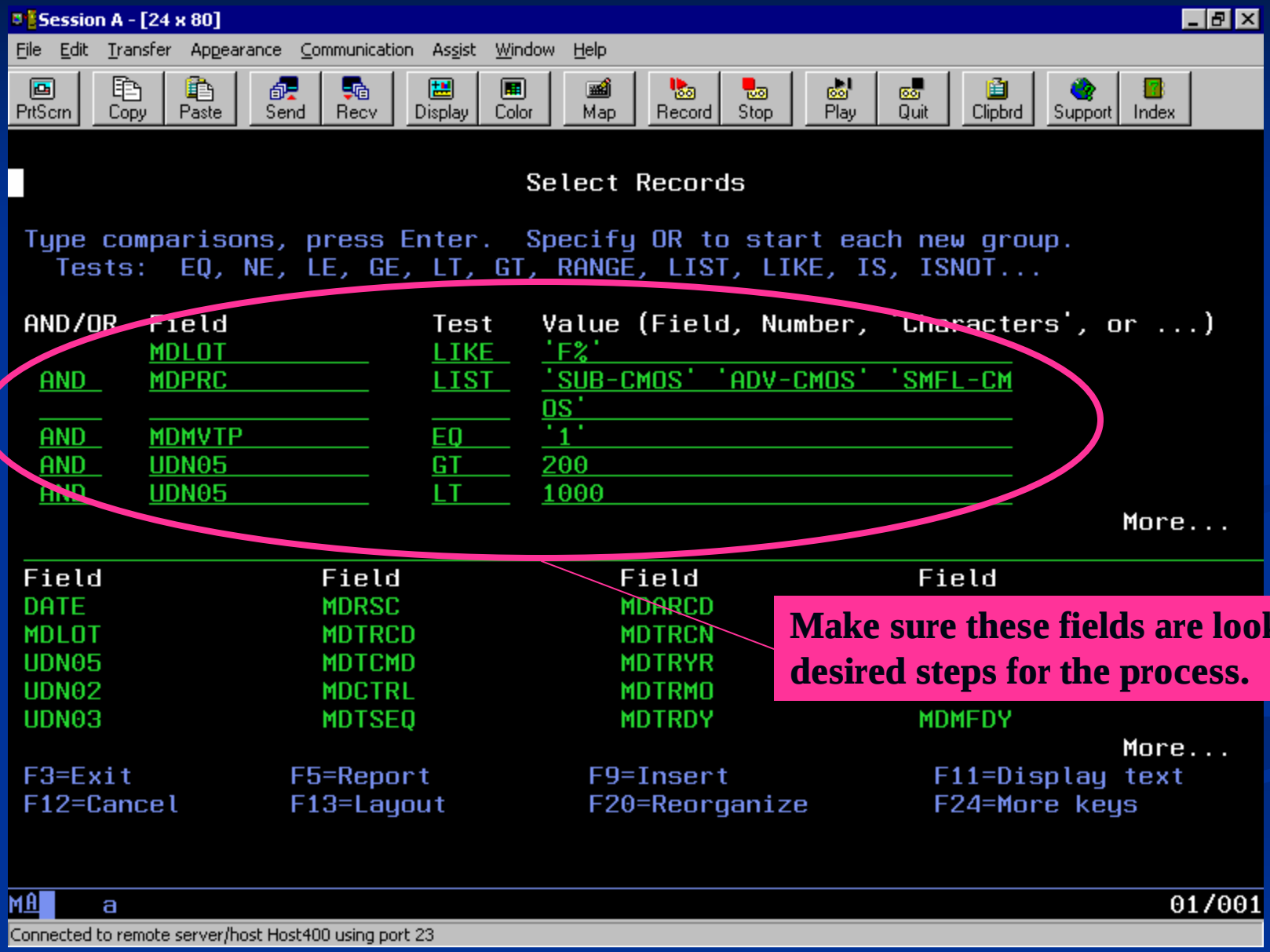
Select the desired Query by typing 5 to Display or 2 to Change it.

Accessing the Queries



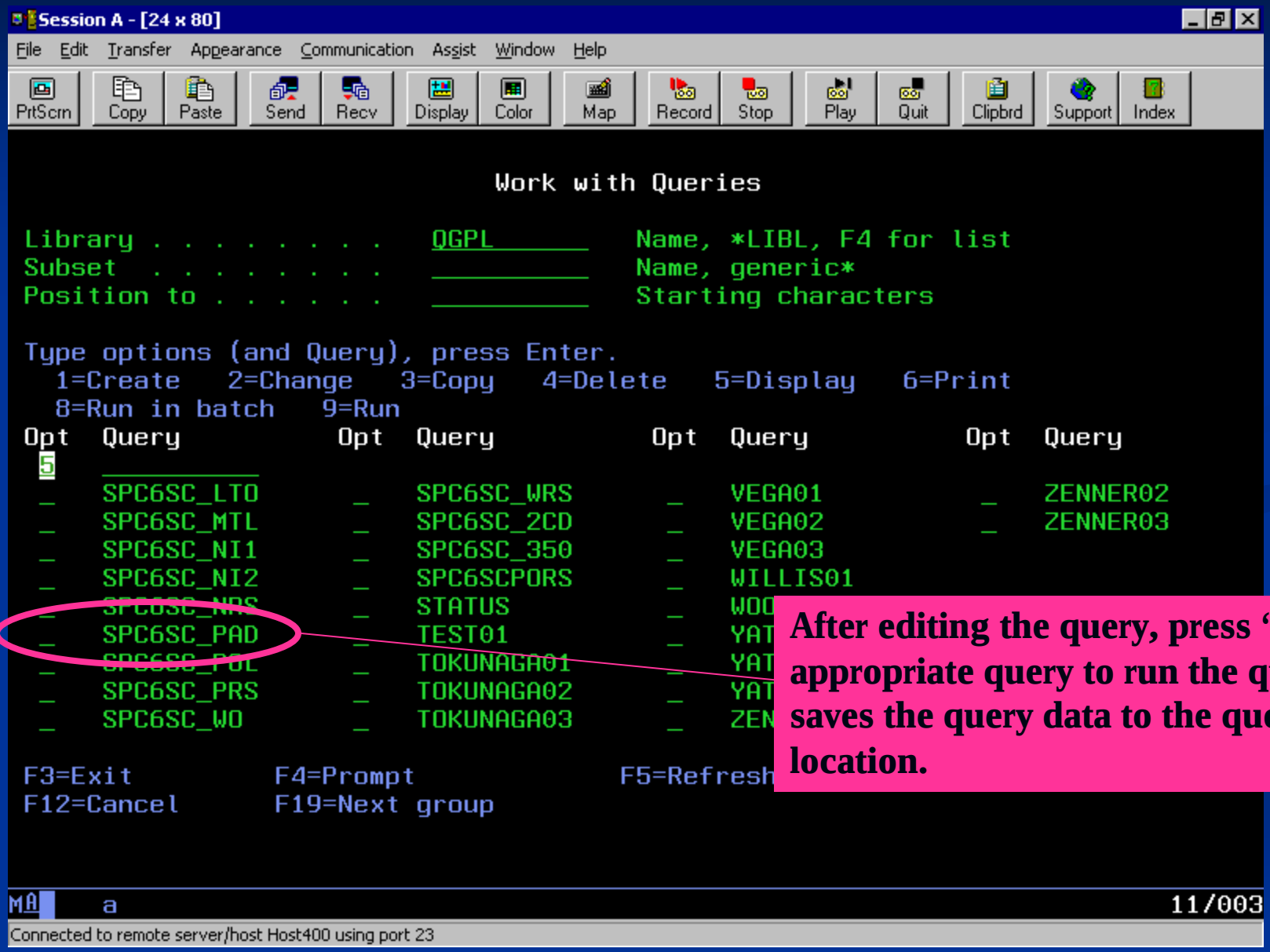
Type 1 to choose, “Select Records”

Accessing the Queries



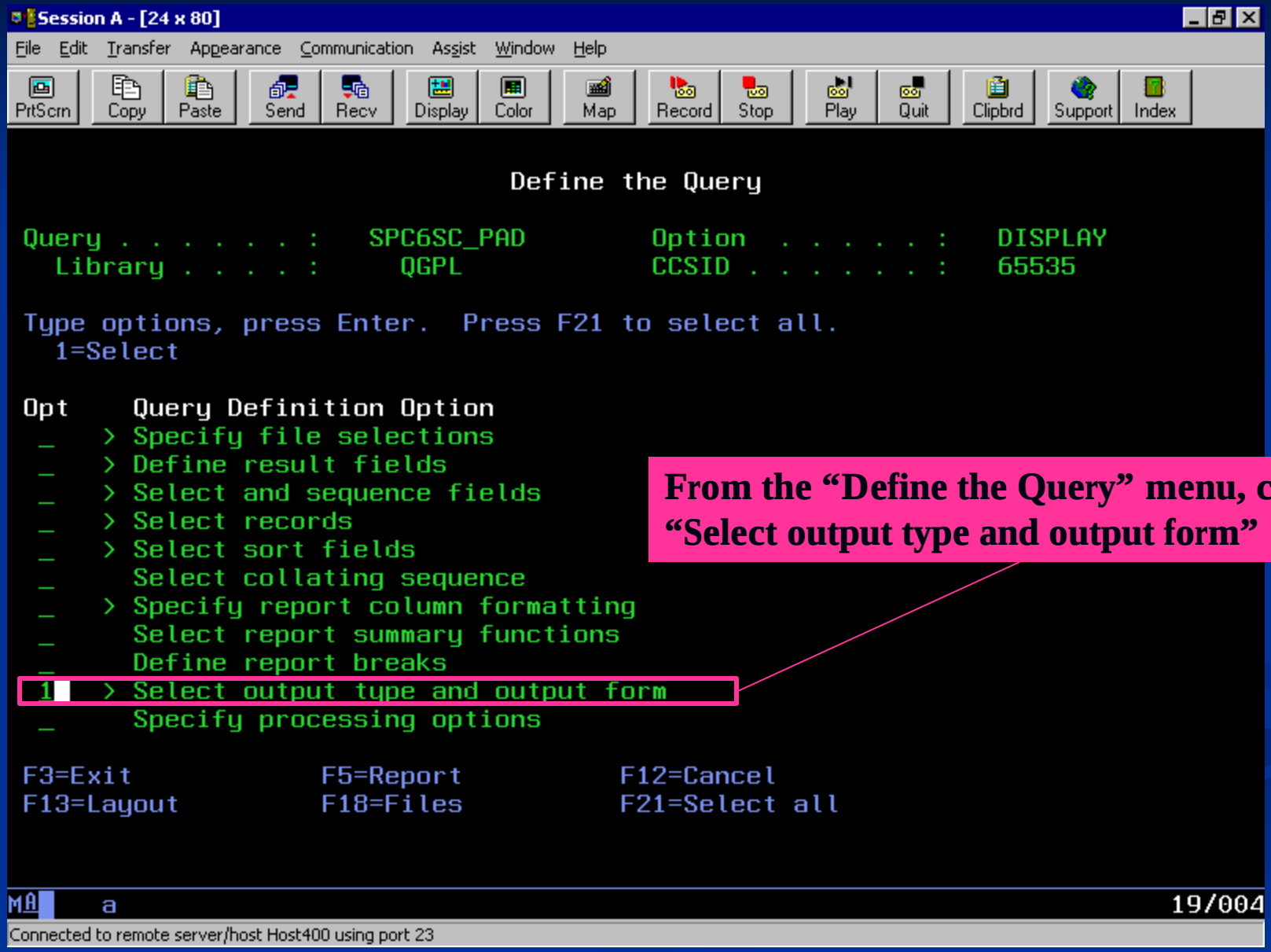
Make sure these fields are looking up all desired steps for the process.

Running The Query



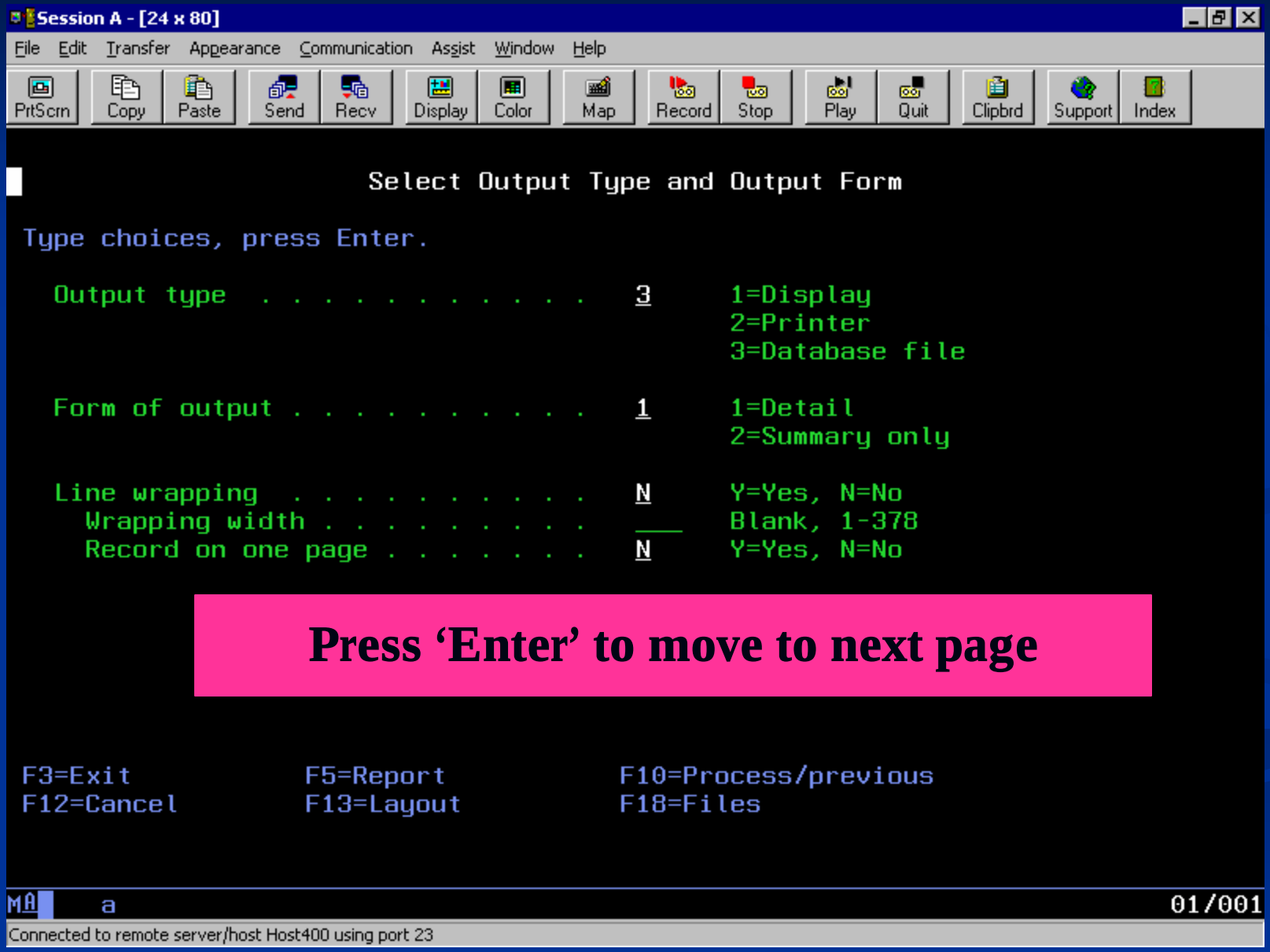
After editing the query, press '9' on the appropriate query to run the query. This saves the query data to the query save location.

Finding The Query Save Location

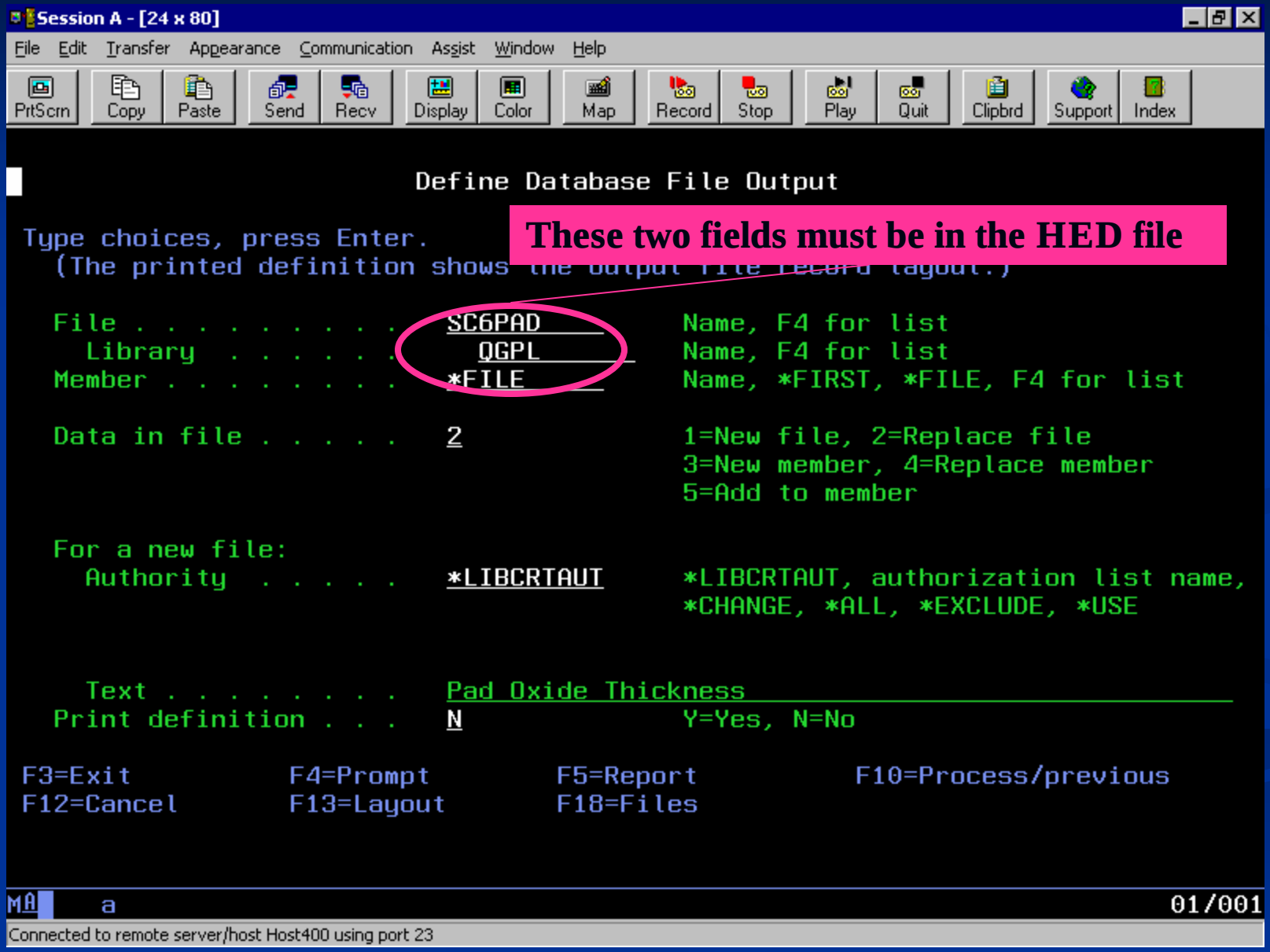


From the "Define the Query" menu, choose "Select output type and output form"

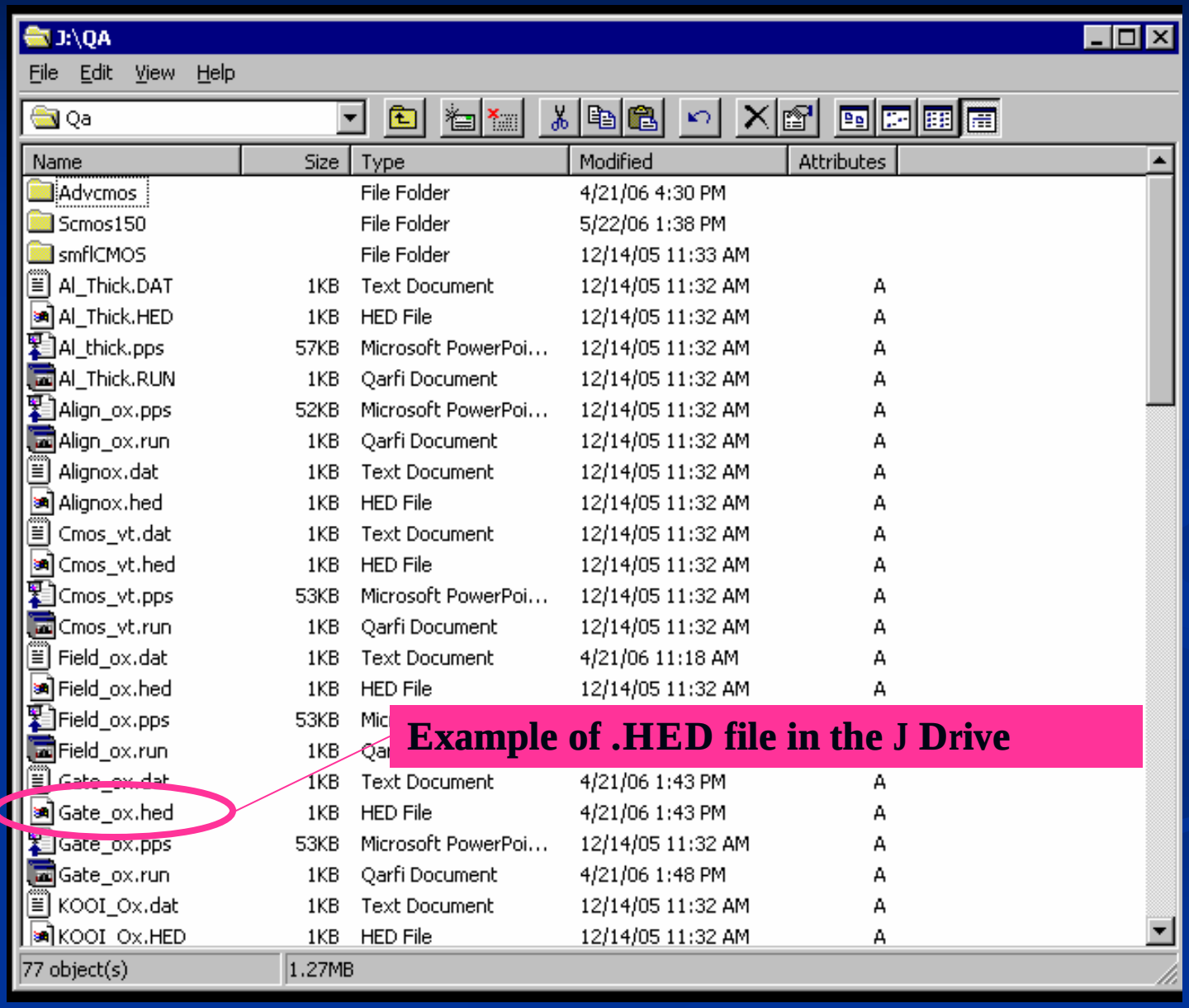
Finding The Query Save Location



Finding The Query Save Location



References in .HED File



References in .HED File

Pad.HED - Notepad

File Edit Search Help

```
KQUALITY ANALYST HEADER FILE v4.1>
<VARS/NMETA/FILEHEAD/MAXHEAD>, 6 , 6 , 1 , 335
Pad thickness
"DATE","I","[DATE]","",""
"MDLOT","A","[MDLOT]","",""
"THICKNES","I","Pad Oxide Thickness, Recipe 250, OX05","",""
"SOAK_TIM","I","Soak time","",""
"SOAK_TEM","I","Soak temp","",""
"MDRSC","A","Furnace ID","",""
<FILE WIDE PARAMETERS>
2 DATE            MDLOT           SOAK_TIM          SOAK_TEM
7 1
8 MESA Files
9 [DATE],[MDLOT],[UDN05],[UDN02],[UDN03],[MDRSC]
10 QGPL.SC6PAD
13 ODBC
0 THICKNES
5 500
11 600
12 400
95 -3
287 0
0 DATE
95 -3
```

This must match the 'Save Location' of the desired Query

References in .HED File

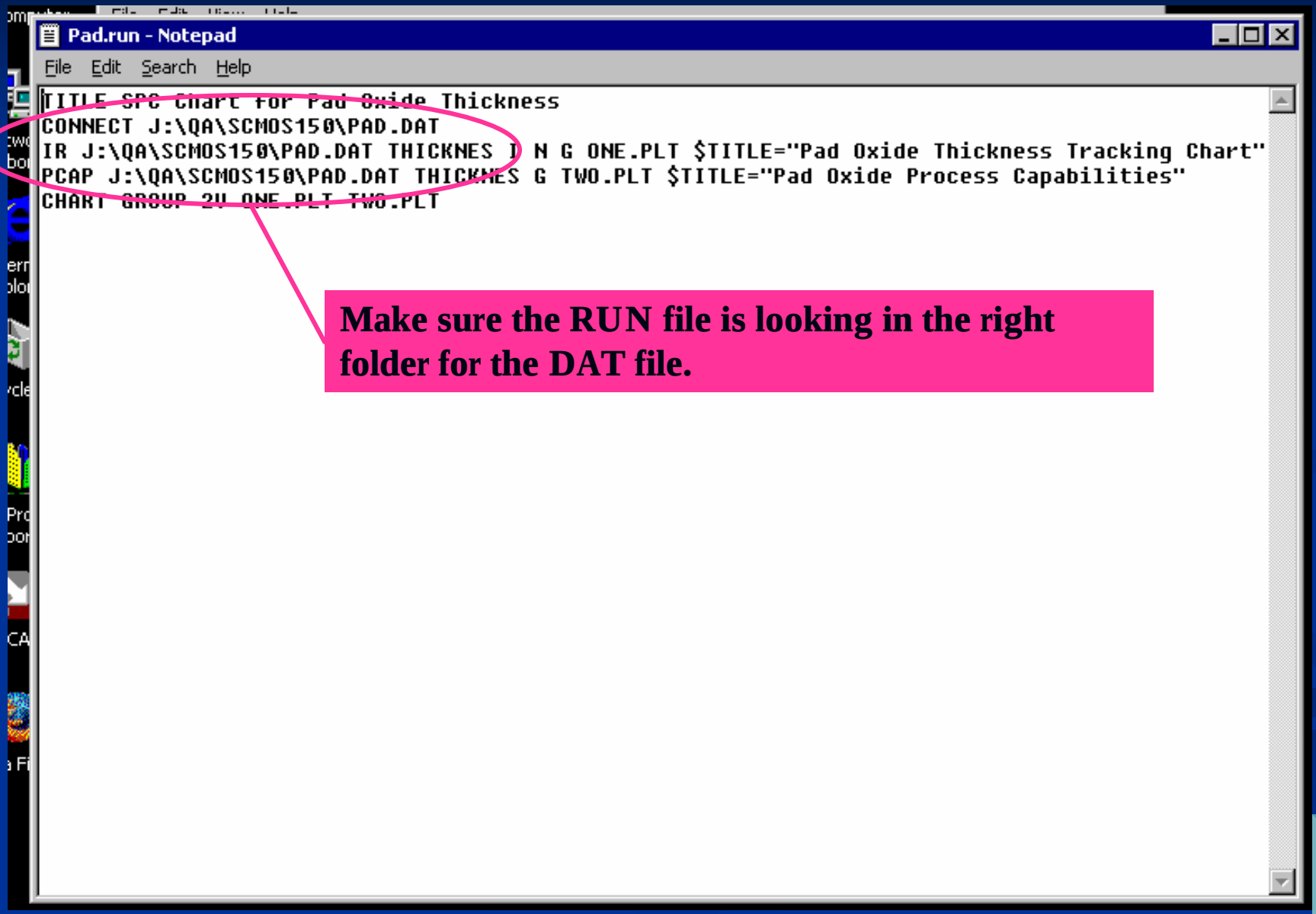
Pad.HED - Notepad

File Edit Search Help

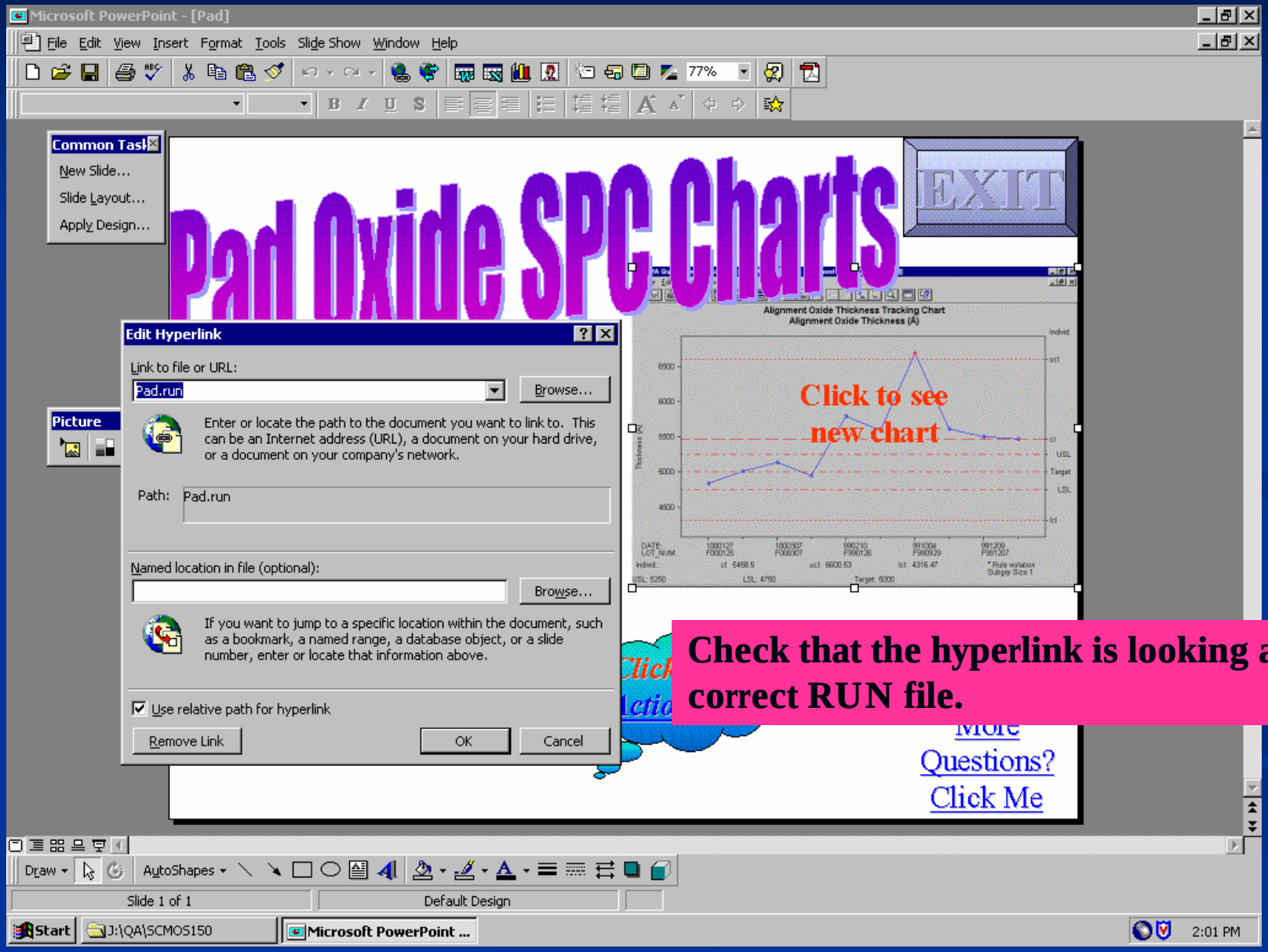
```
KQUALITY ANALYST HEADER FILE v4.1>
<VARS/NMETA/FILEHEAD/MAXHEAD>, 6 , 6 , 1 , 335
Pad thickness
"DATE","I","[DATE]","",""
"MDLOT","A","[MDLOT]","",""
"THICKNES","I","Pad Oxide Thickness, Recipe 250, OX05","",""
"SOAK_TIM","I","Soak time","",""
"SOAK_TEM","I","Soak temp","",""
"MDRSC","A","Furnace ID","",""
<FILE WIDE PARAMETERS>
2 DATE          MDLOT          SOAK_TIM          SOAK_TEM
7 1
8 MESA Files
9 [DATE],[MDLOT],[UDN05],[UDN02],[UDN03],[MDRSC]
10 QGPL.SC6PAD
13 ODBC
0 THICKNES
5 500
11 600
12 400
95 -3
287 0
0 DATE
95 -3
```

These numbers set the target, USL, and LSL respectively.

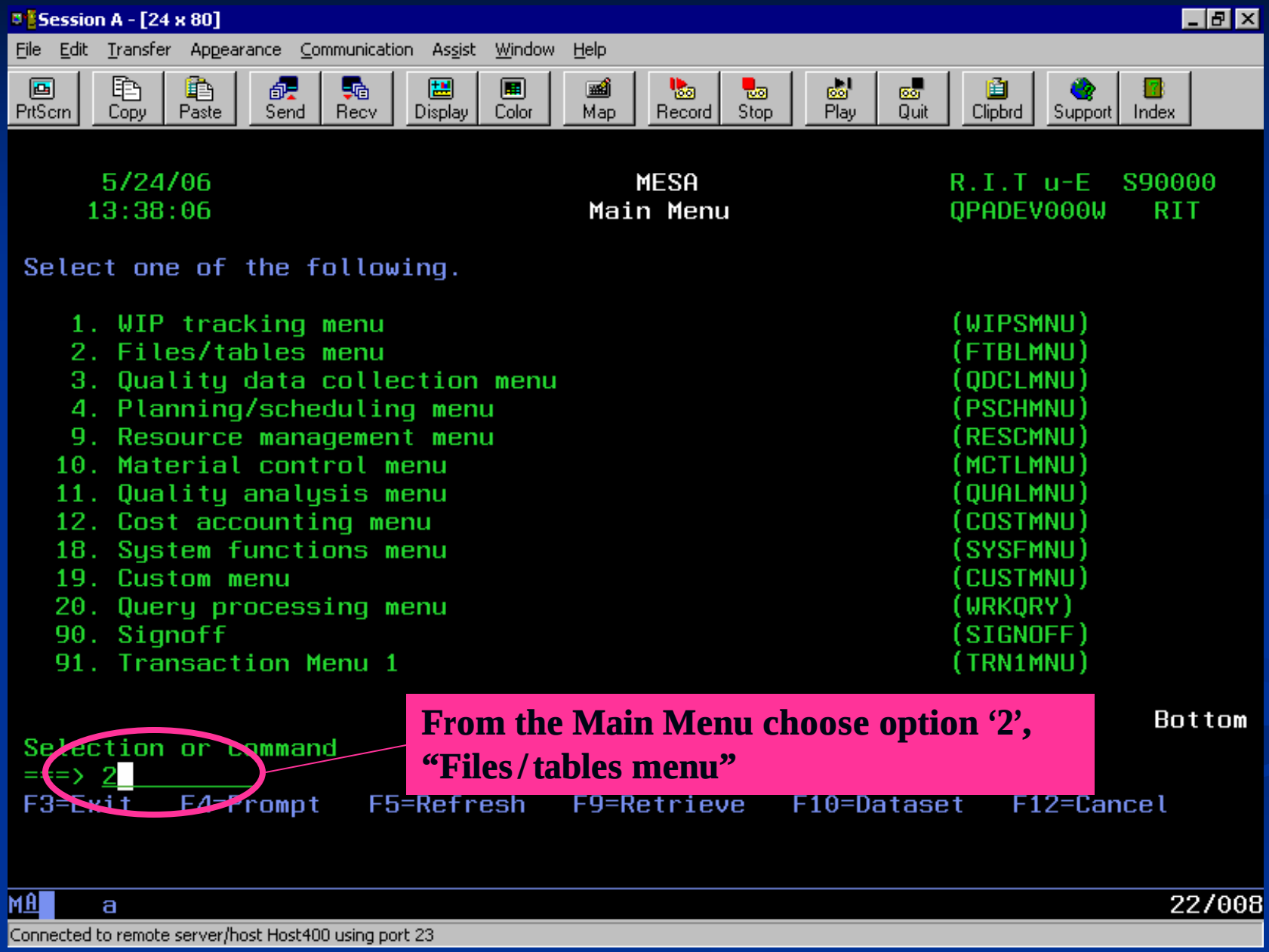
Run File


Pad.run - Notepad
File Edit Search Help
TITLE SPC Chart for Pad Oxide Thickness
CONNECT J:\QA\SCMOS150\PAD.DAT
IR J:\QA\SCMOS150\PAD.DAT THICKNES I N G ONE.PLT $TITLE="Pad Oxide Thickness Tracking Chart"
PCAP J:\QA\SCMOS150\PAD.DAT THICKNES G TWO.PLT $TITLE="Pad Oxide Process Capabilities"
CHART GROUP 2U ONE.PLT TWO.PLT
Make sure the RUN file is looking in the right folder for the DAT file.

Power Point Show

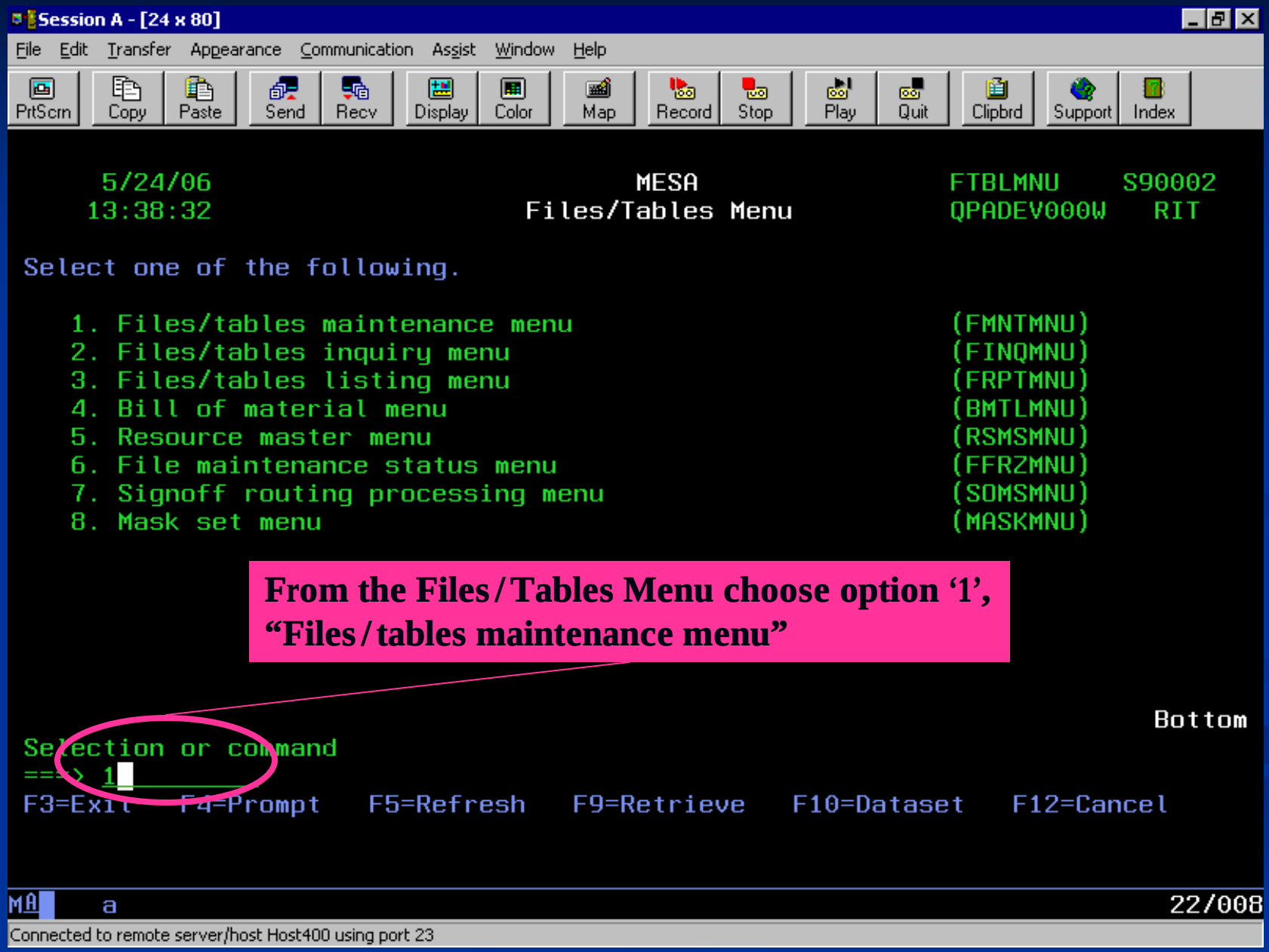


MESA Document

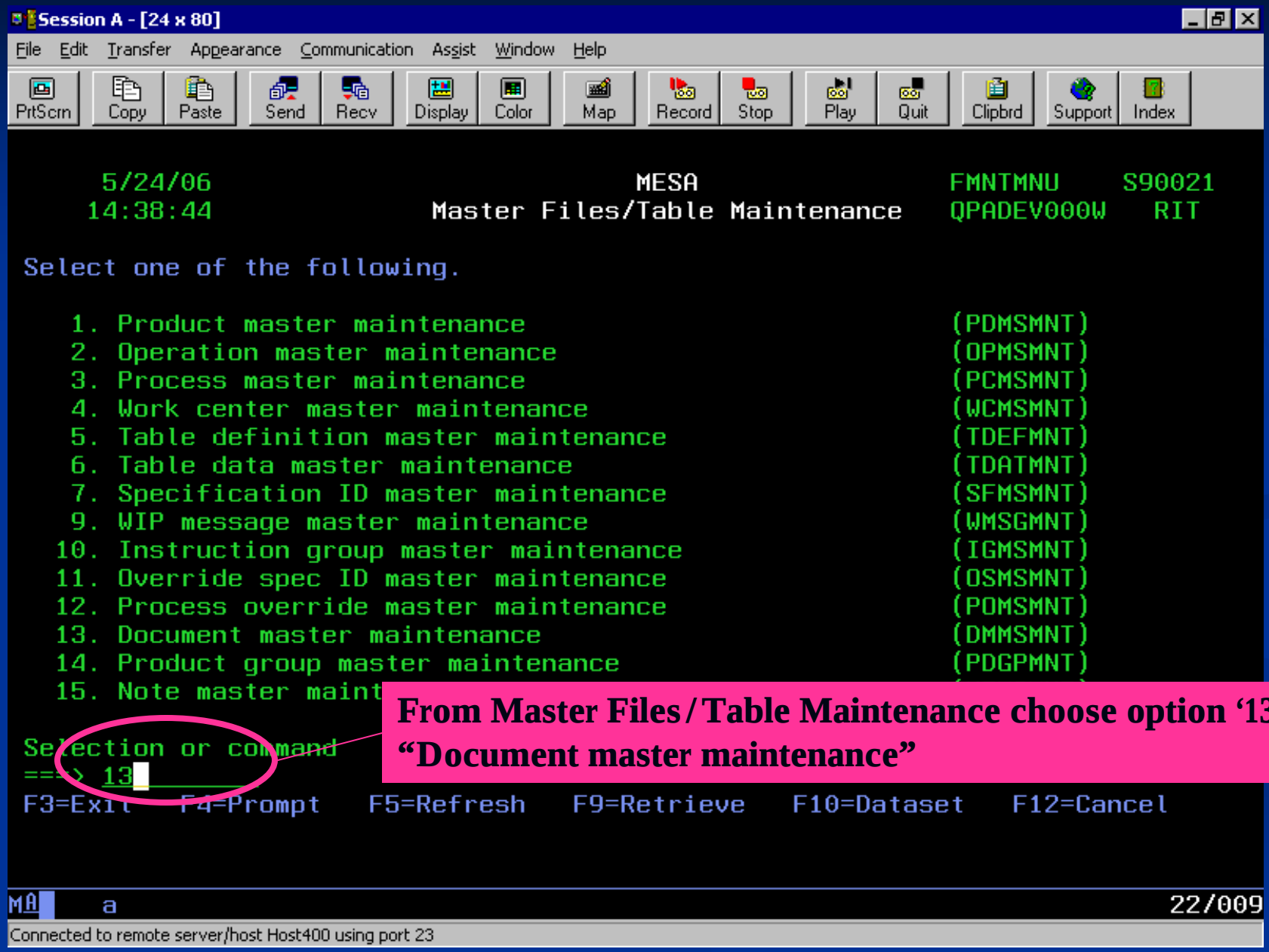


From the Main Menu choose option '2', "Files/tables menu"

MESA Document

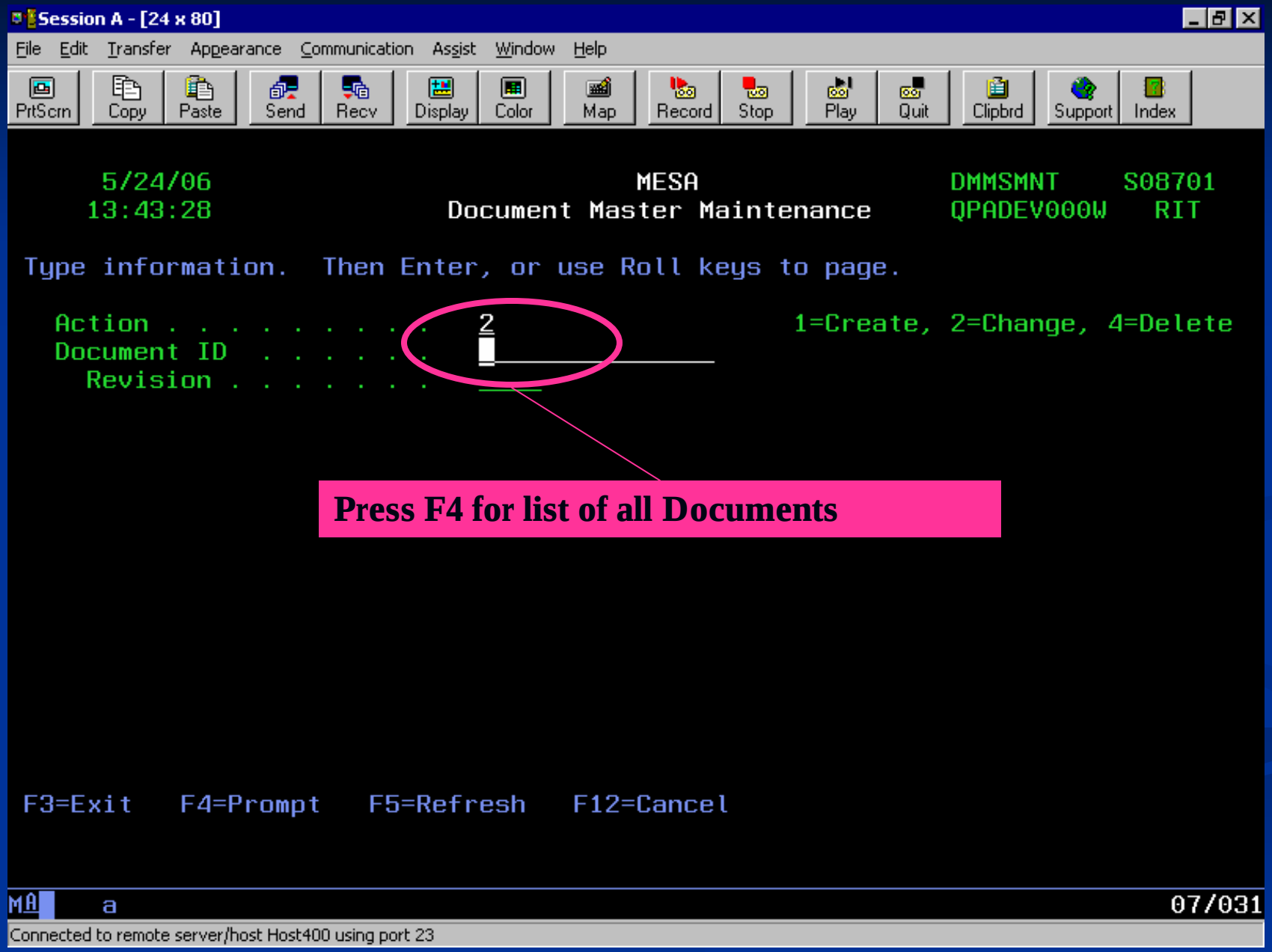


MESA Document

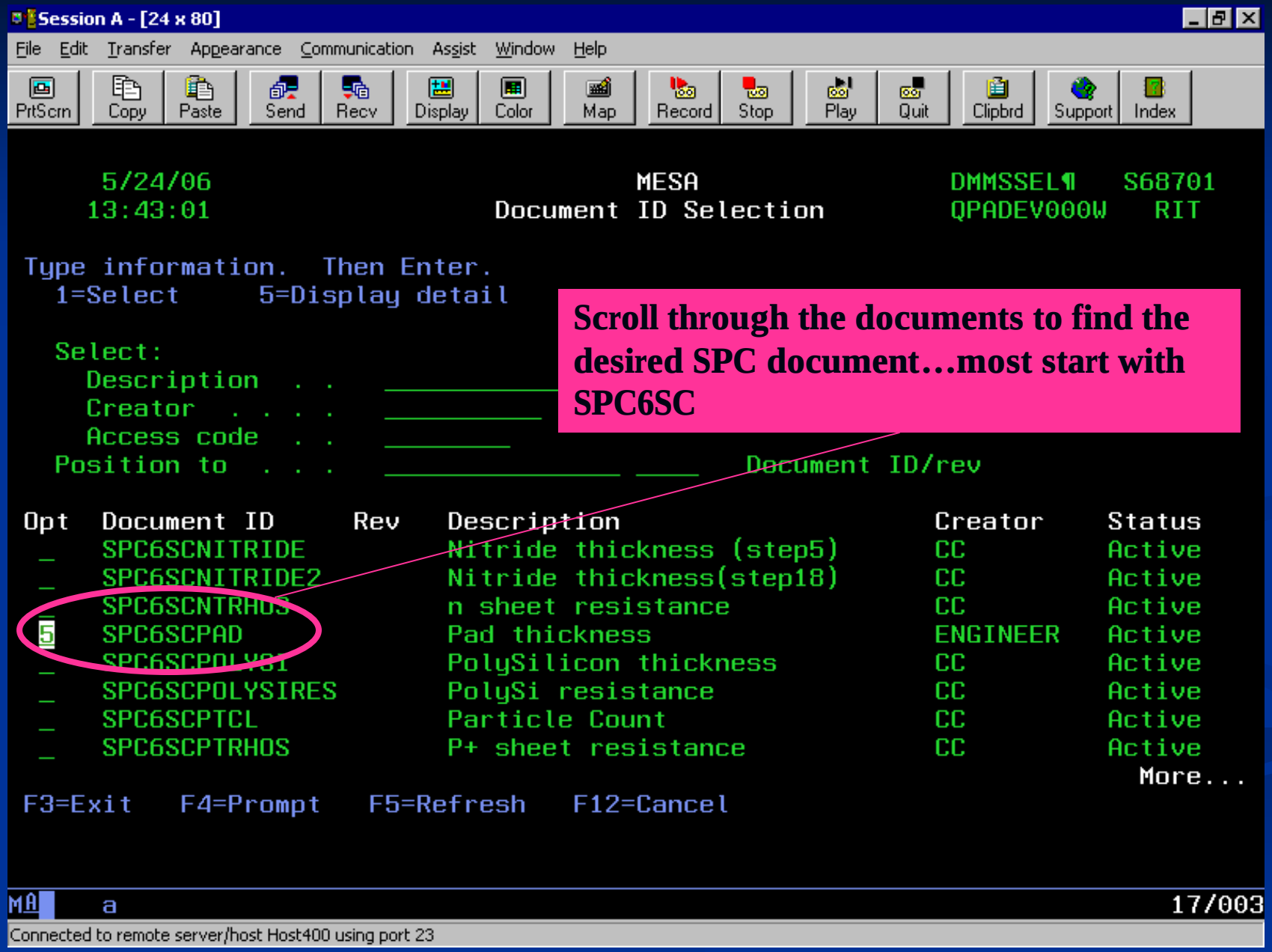


From Master Files / Table Maintenance choose option '13', "Document master maintenance"

MESA Document

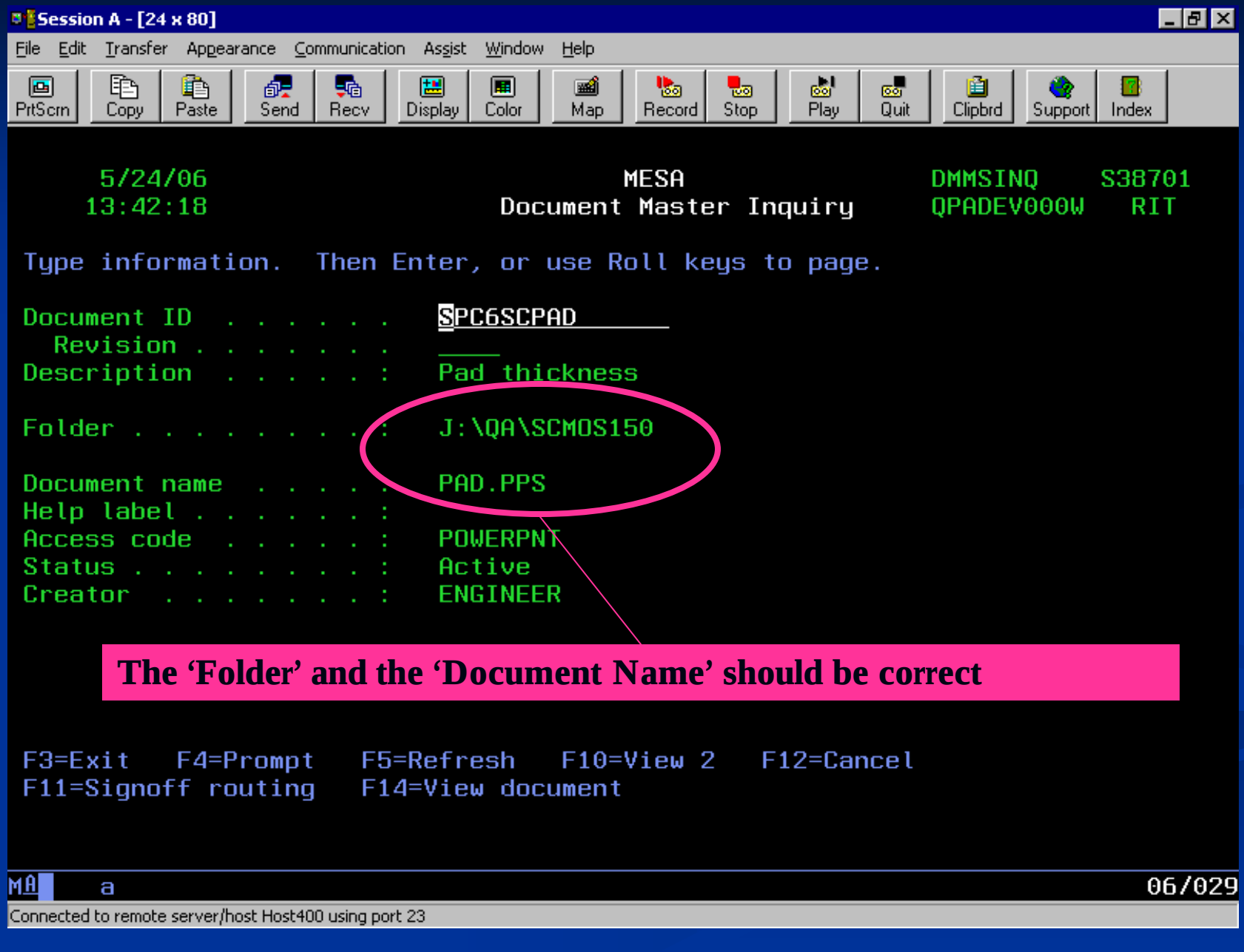


MESA Document

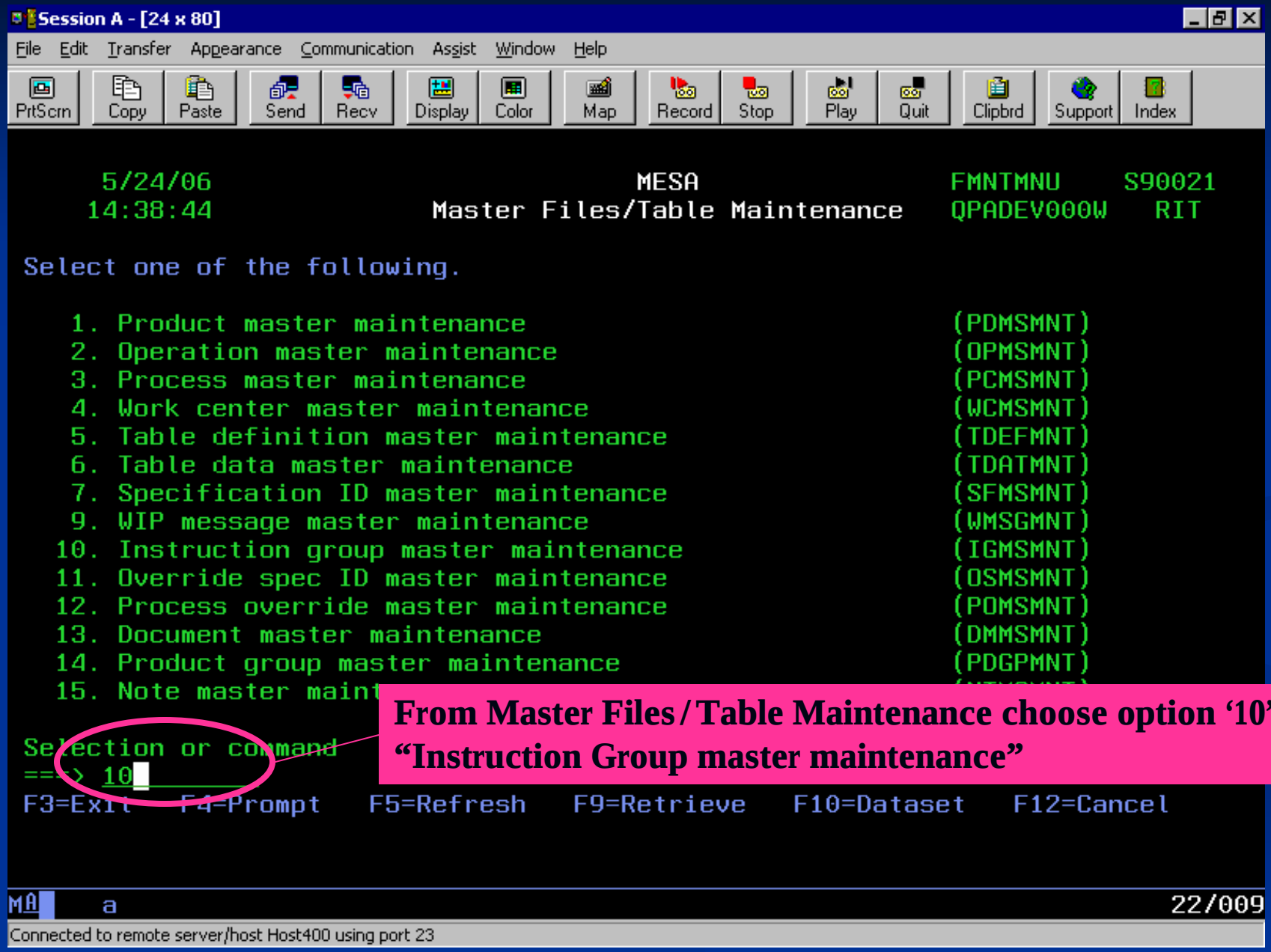


Scroll through the documents to find the desired SPC document…most start with SPC6SC

MESA Document

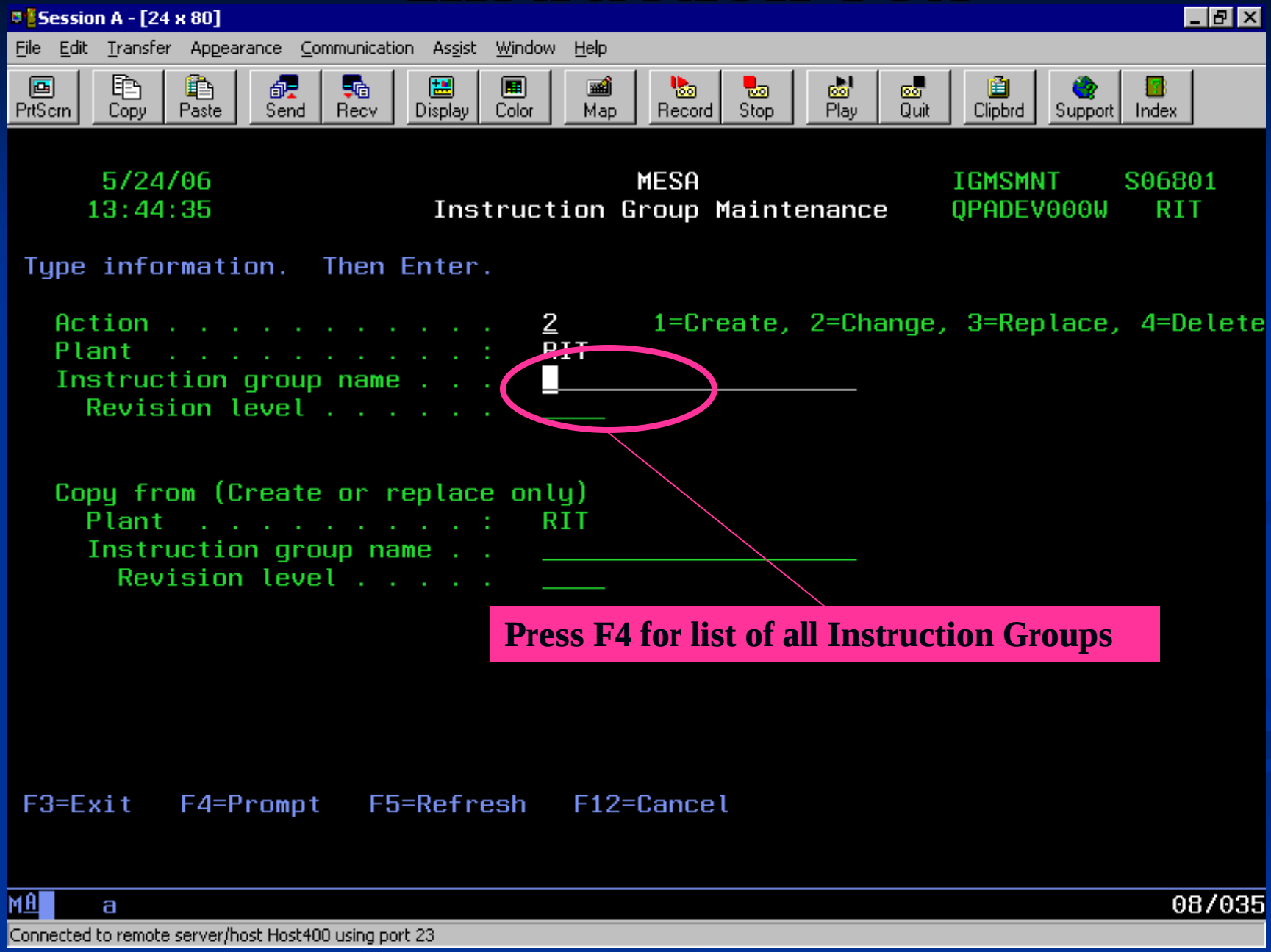


Instruction Sets

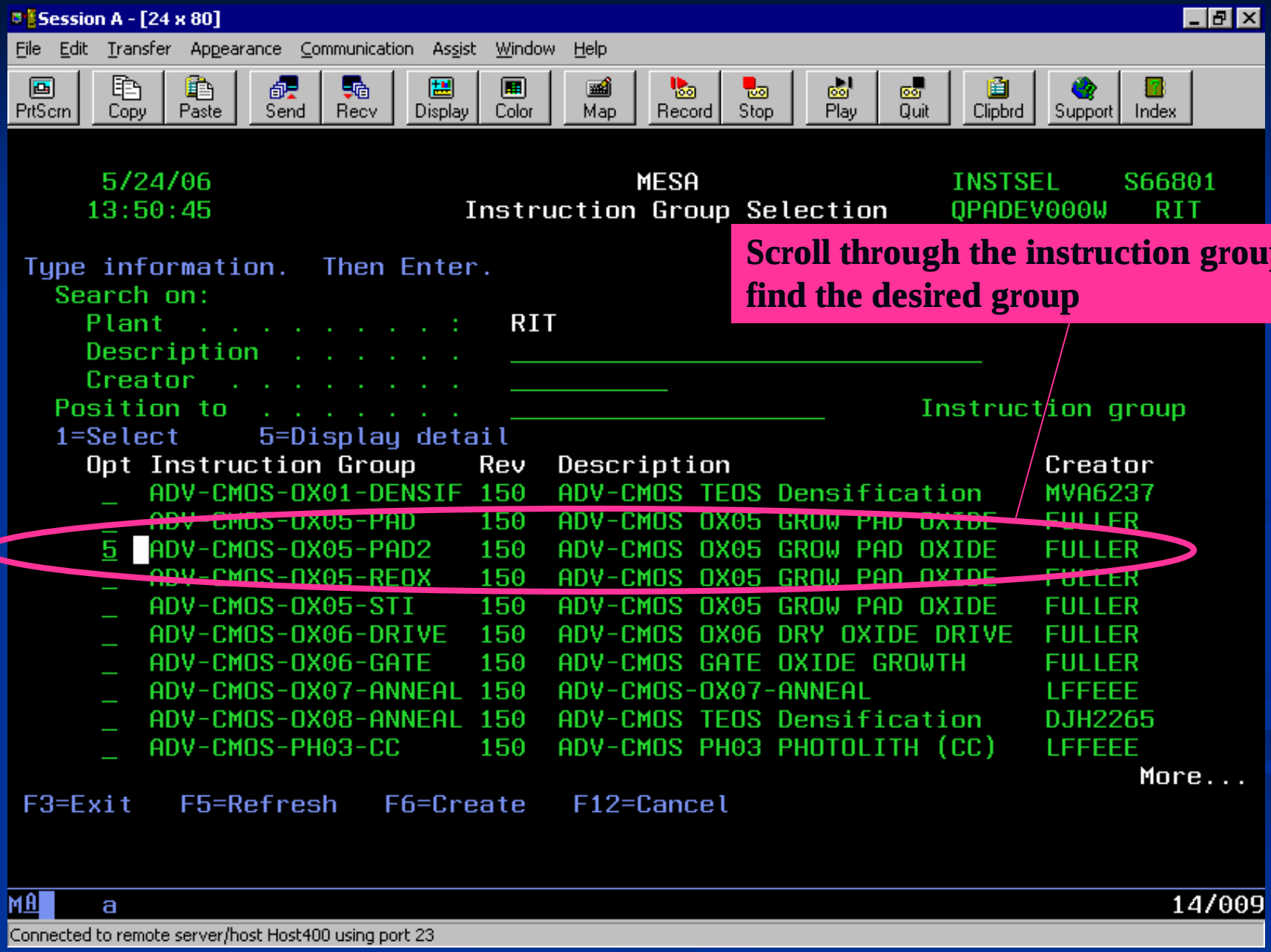


From Master Files / Table Maintenance choose option '10', "Instruction Group master maintenance"

Instruction Sets

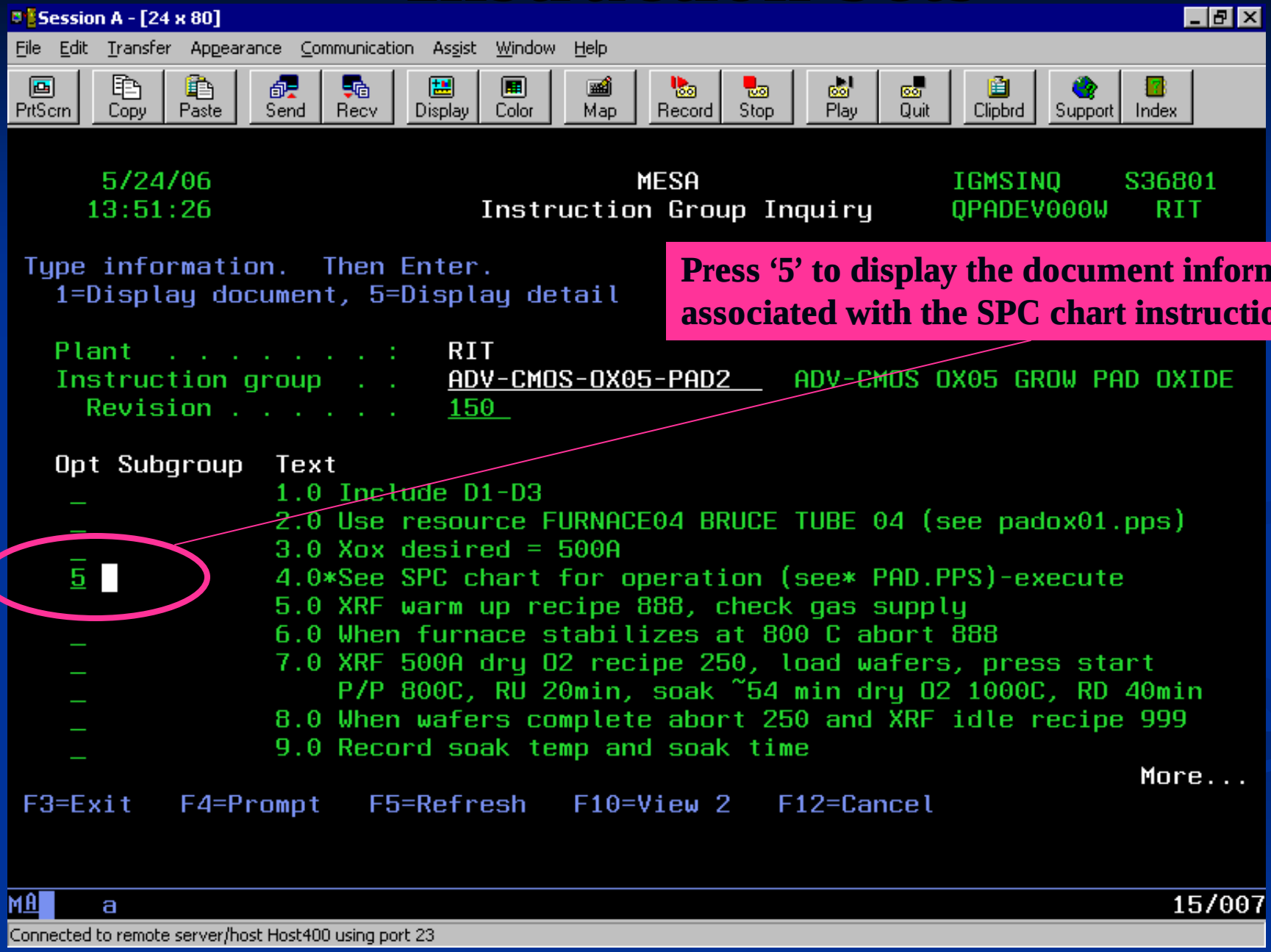


Instruction Sets



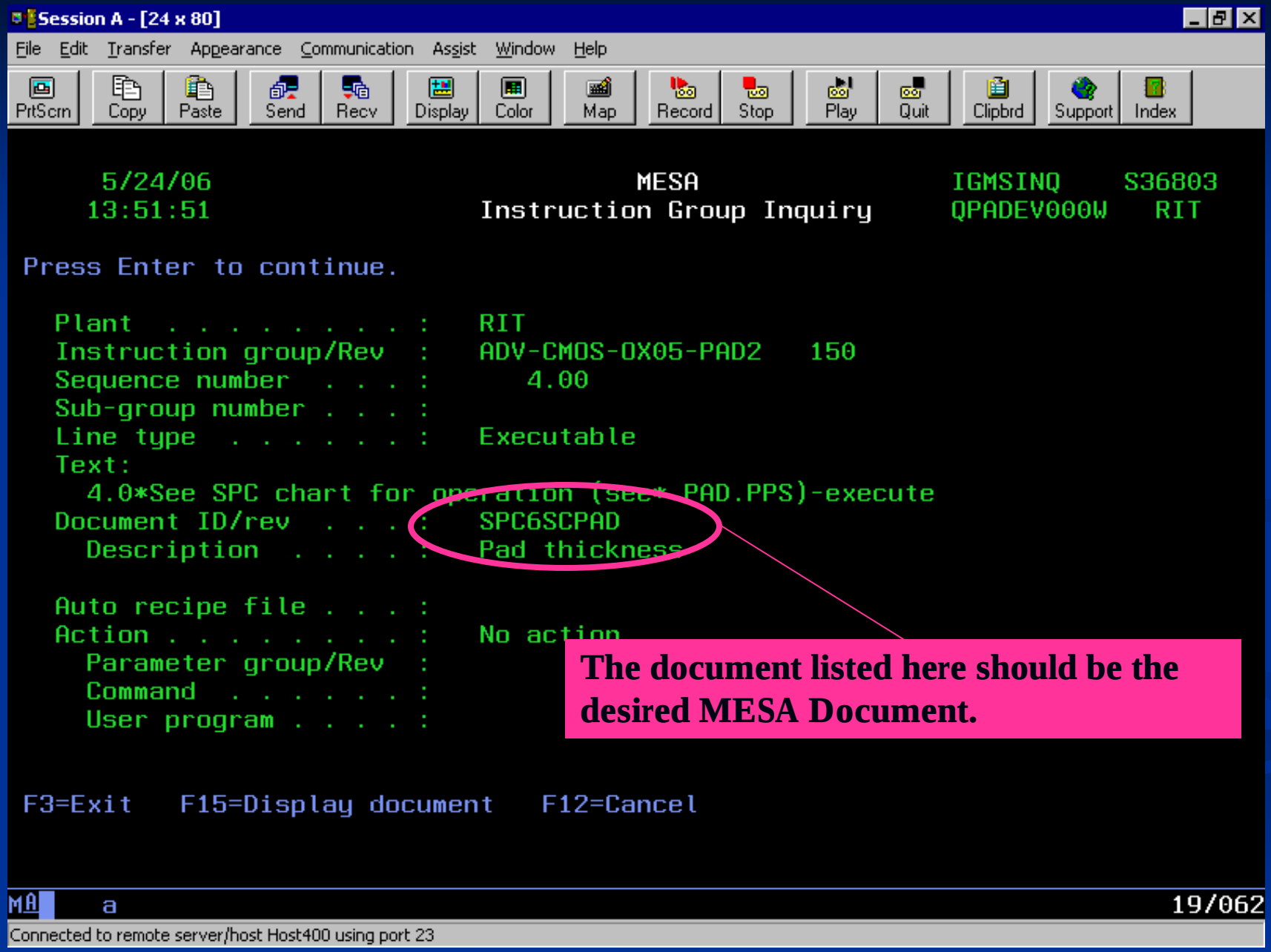
Scroll through the instruction groups to find the desired group

Instruction Sets



Press '5' to display the document information associated with the SPC chart instruction

Instruction Sets



The document listed here should be the desired MESA Document.