




## Using XML For Navy Missile Systems

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## System Challenges



- Long life span
- Multiple sites
- Fully redundant
- Safety concerns
- Hostile environment
- Since 1950's
- World-wide mobile sites
- Battle damage
- Nuclear
- Runs underwater

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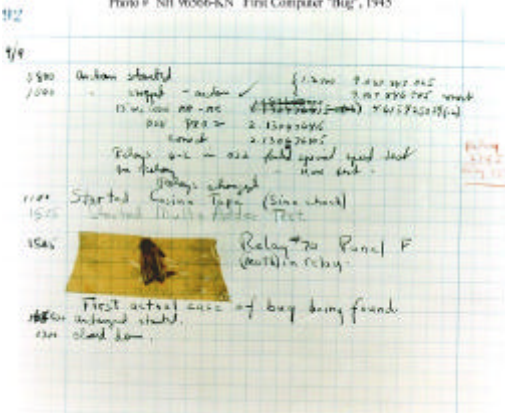
## Dahlgren Division



- Three major sites
  - Dahlgren, Virginia
    - 5000 employees and contractors
  - Panama City, Florida
  - Dam Neck, Virginia
- Research, development, test and evaluation
- Engineering and fleet support activities for surface warfare, surface ship combat systems, ordnance, strategic systems, amphibious warfare, mines and mine countermeasures, and amphibious and special warfare systems

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Photo # NH 96566-KN First Computer "Bug", 1945



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## US Submarines

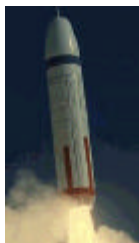


- SSN—attack ships and subs
- SSBN—strategic deterrence
  - 24 long-range strategic missiles (50% of US warheads)
  - Survivable, re-targetable nuclear strike capability
  - 560 feet, 16K tons, 155 crew
- SSGN—converted SSBN's for modern warfare
  - 154 tactical cruise missiles
  - Peace-time, conventional deterrent, and combat missions
  - 66 Special Operations Forces personnel

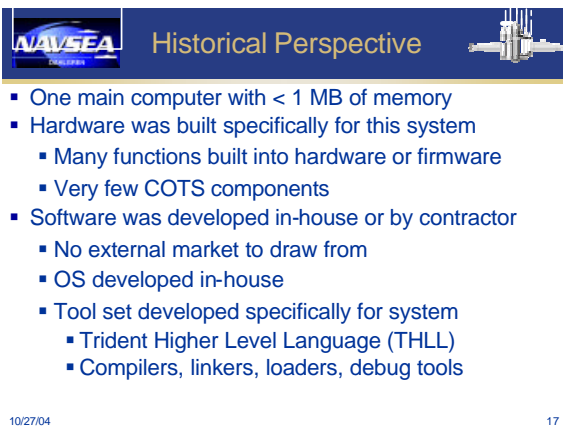
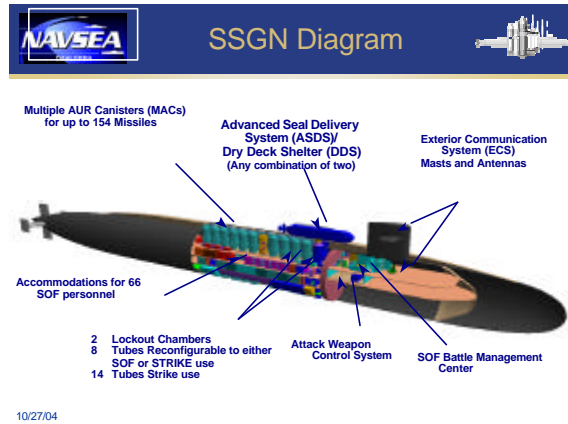
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- **Trident Fleet Ballistic Missile**
  - Polaris (1956), Poseidon, Trident I, Trident II
  - 44 ft, 130K lbs, 20K ft per second (6 km per second)
  - Range more than 4600 miles
  - \$30.9 million each
- **Tomahawk Cruise Missile**
  - Several variants
  - 20.5 ft, 2900 lbs, 550 mph
  - Range approximately 1000 miles
  - \$600K each



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## Using XML to Simplify Operator Procedures



## Background



- Standard Operating Procedures (SOPs) are used to conduct all operations on the weapons system
- SOPs contain rigid step by step checklist
- Majority of procedures have migrated from paper to electronic
  - Title XVII: Government Paperwork Elimination Act – *“acquisition and use of information technology, to include alternative information technologies that provide for electronic submission, maintenance, or disclosure of information as a substitute for paper”*

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## Background (cont)



- Leverage system information to better control application flow
- Perform the task in the correct sequence while accounting for variations in system configuration
- Software directs the appropriate action at the appropriate time

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## XML in Government



The Senate and the ...House have worked together...to create Document Type Definition files (DTDs) for use in the creation of legislative documents using XML.

—xml.house.gov

The DoD XML Registry constitutes guidance in the generation and use of XML among DoD communities....


—Defense Information Systems Agency

The Department of the Navy will fully exploit Extensible Markup Language as an enabling technology to achieve interoperability in support of maritime information superiority

—DON CIO

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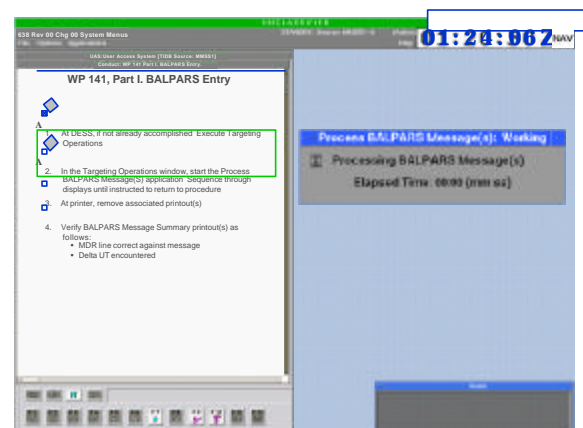
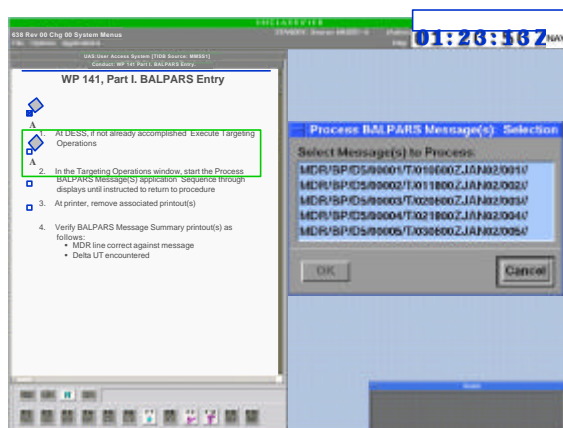
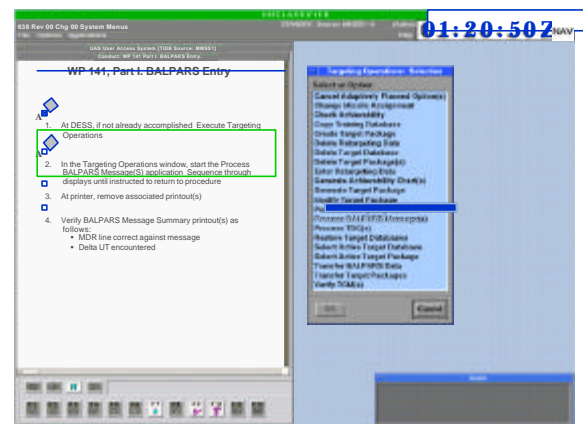
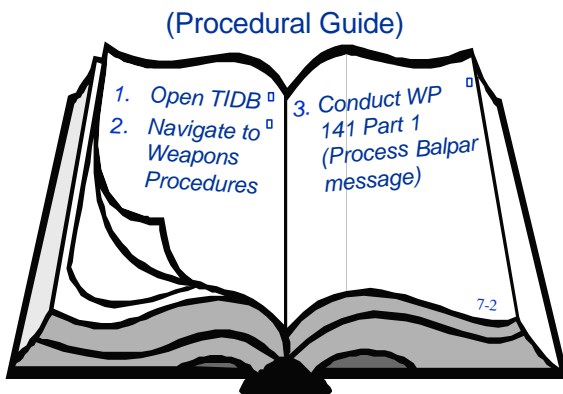
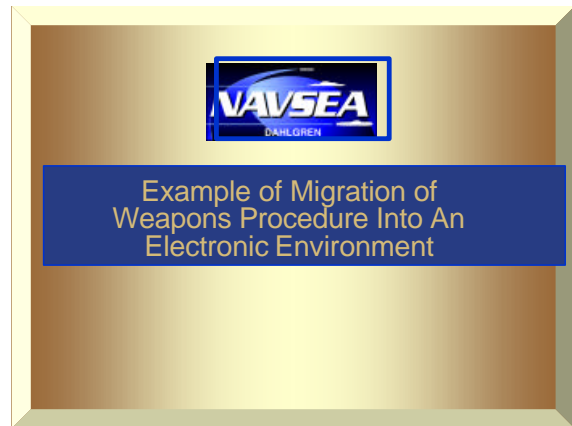
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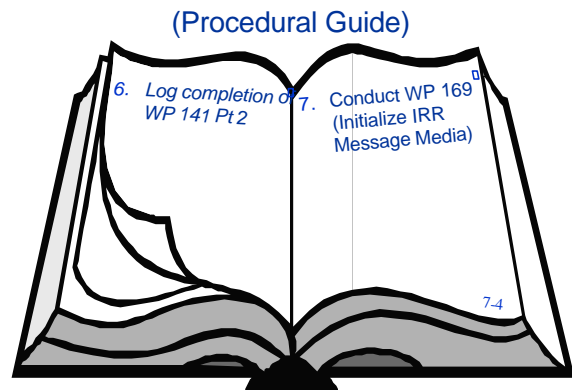
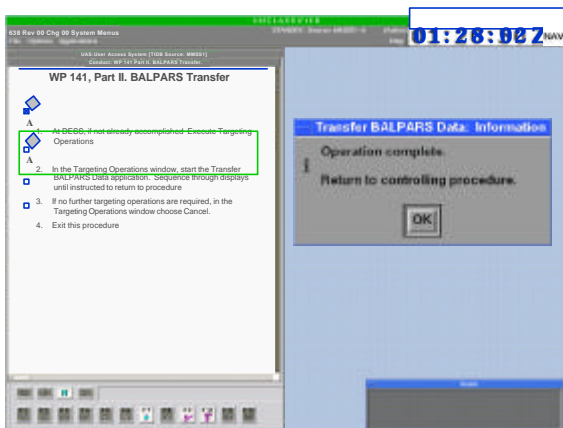
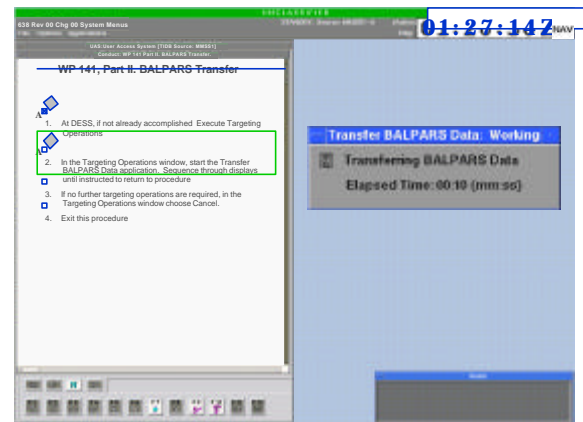
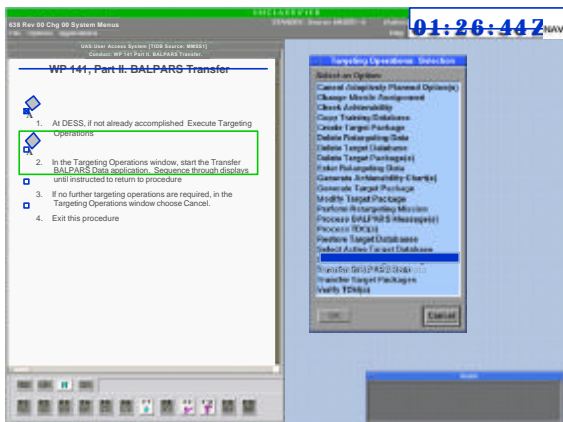
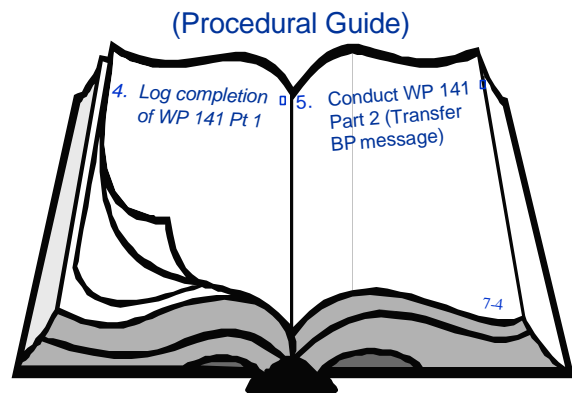
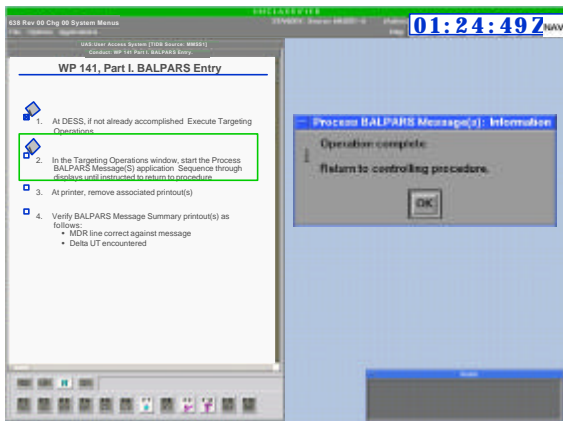


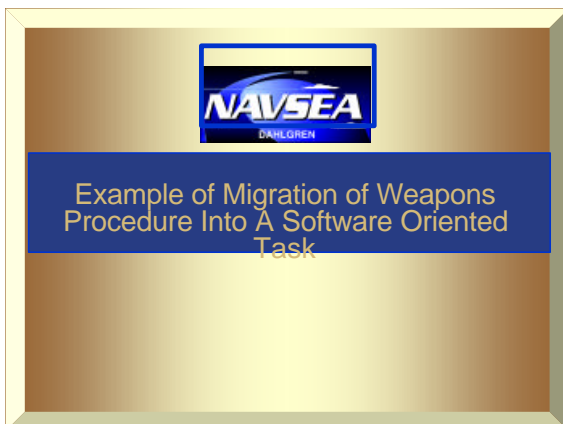
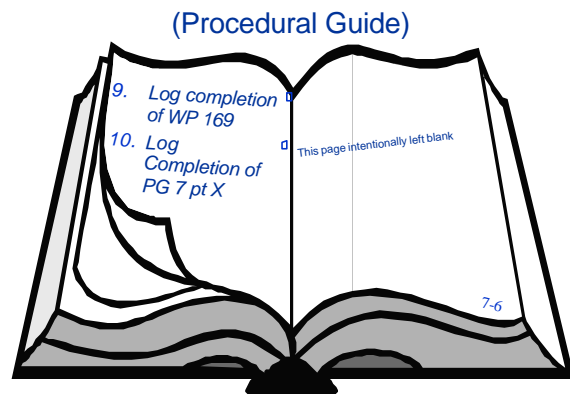
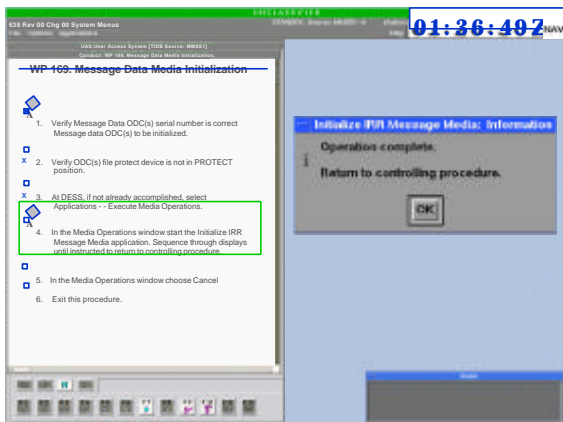
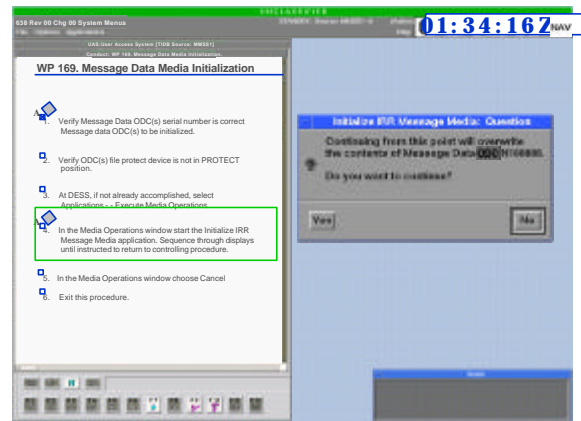
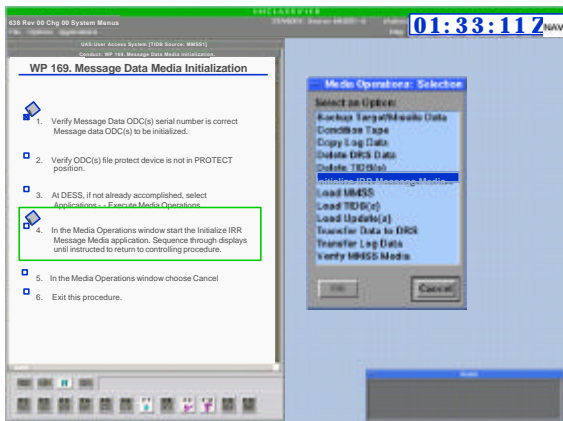
## Example of Paper Procedure (Previous Software)



1. Verify Message Data MTC serial number written on BALPARS message matches Message Data MTC serial number.
2. On OCP, select Primary Mode DATA ENTRY and depress ENTER.
3. At DES, enter BALPARS data as follows:
  - A. Select PERFORM DATA ENTRY OPERATIONS and depress ENTER.
  - B. Select MESSAGE OPERATIONS and depress ENTER.
  - C. Select PROCESS IRR TAPE MESSAGE and depress ENTER.
  - D. Enter MTC serial number, N000000, from message.
  - E. Verify serial number displayed correct against MTC and depress ADV PAGE.
  - F. When SELECT TAPE DRIVE is displayed, select MTFSS 1 and depress ENTER.
  - G. When MOUNT TAPE ON MTFSS 1 is displayed, install MTC, observe DRIVE READY is GREEN and depress ADV PAGE.
  - H. Verify MDR line displayed correct against line on message. As necessary, select SKIP MESSAGE DATA and depress ENTER to obtain the correct display.
  - I. If not already accomplished, set NMSS PROTECT keylock to NMSS 1 NON PROTECT.
  - J. Select PROCESS MESSAGE DATA and depress ENTER.



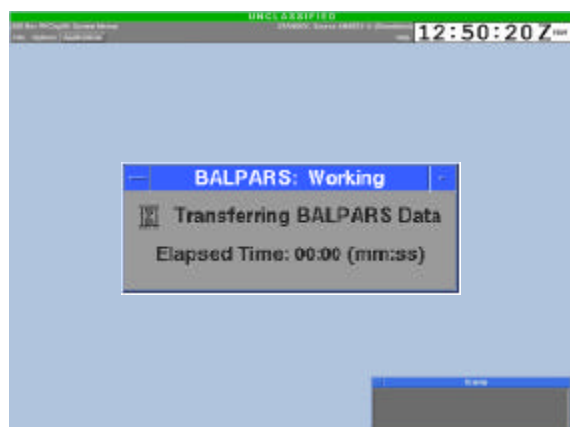
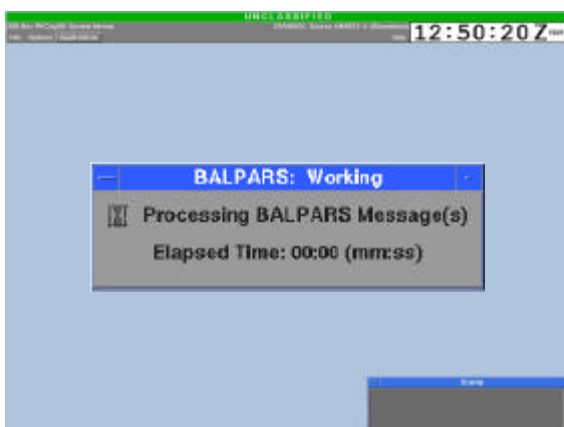
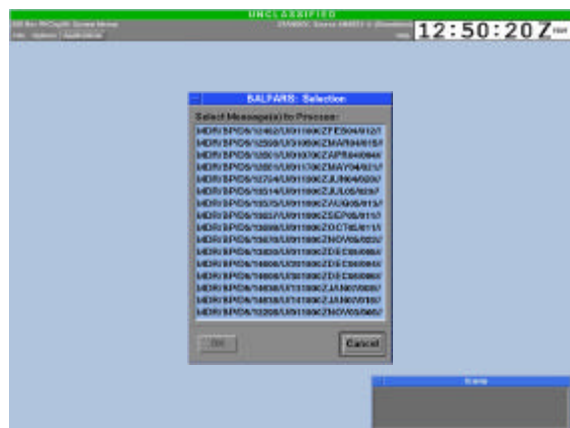
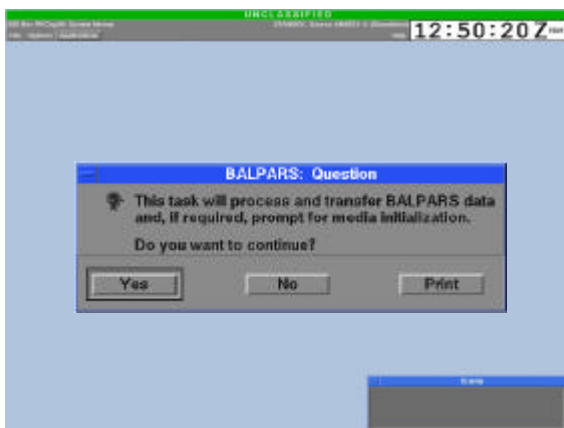
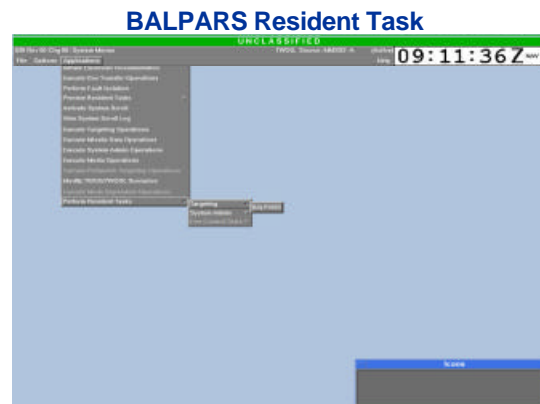
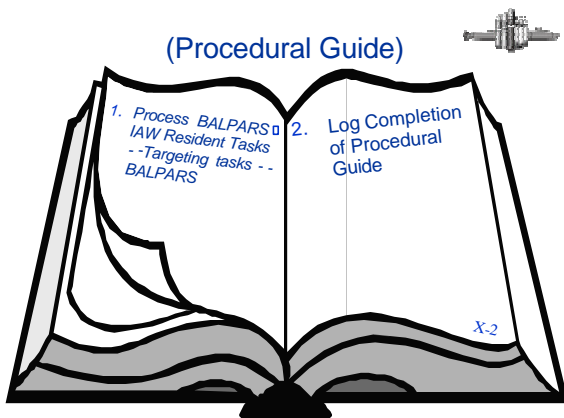




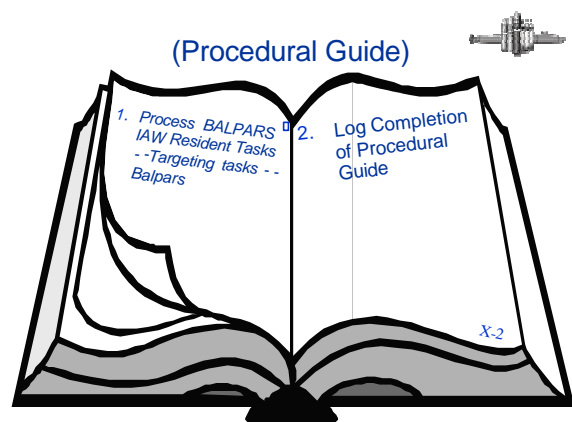
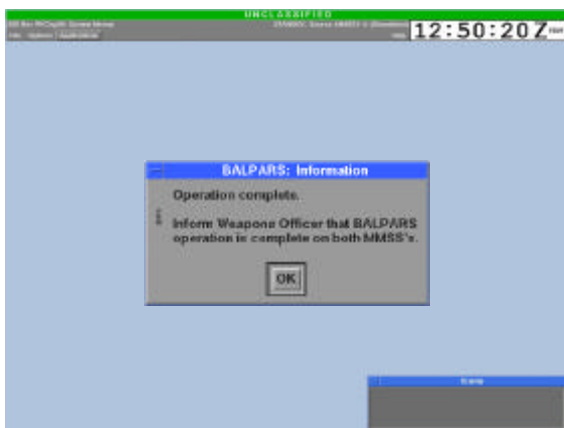
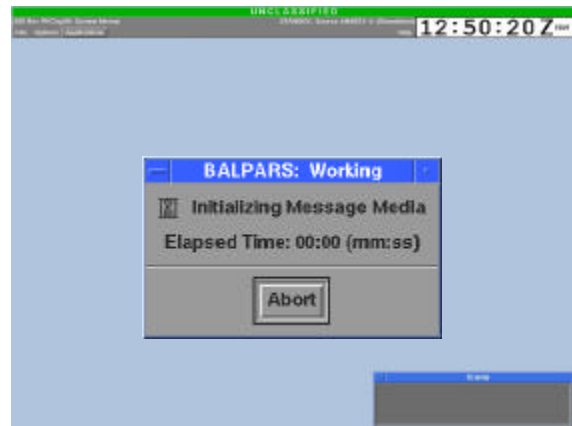
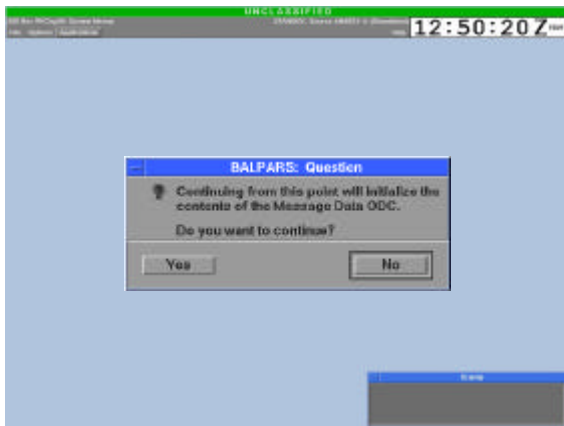
- BALPARS Resident Task combines three separate FC Applications into a single operation that is sequenced by the FCS.

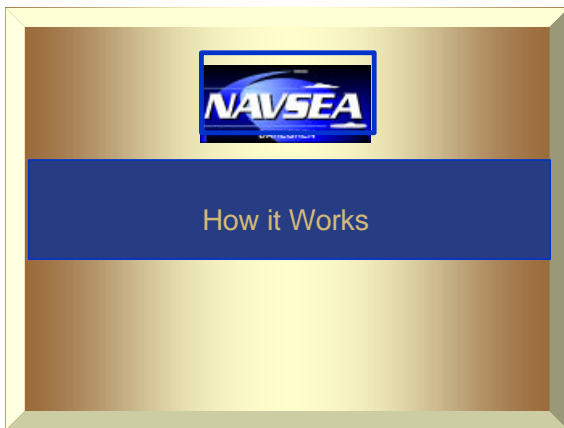
BALPARS Entry  
 BALPARS Transfer  
 Message Data Media Initialization

} BP Resident Task





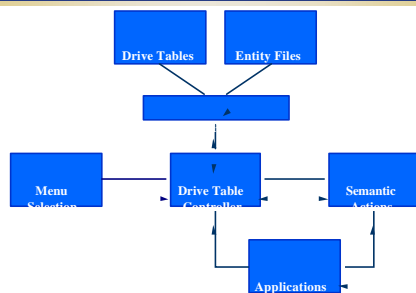




- **Drive Table**—XML file that contains the steps of a task
- **Entity File**—strings used by a Drive Table
- **Drive Table Controller (DTC)**—software that interprets a Drive Table and carries out its instructions
- **Semantic Actions**—special functions called by the DTC when instructed by a Drive Table
- **Resident Task**—a single procedure encapsulated in one or more Drive Tables

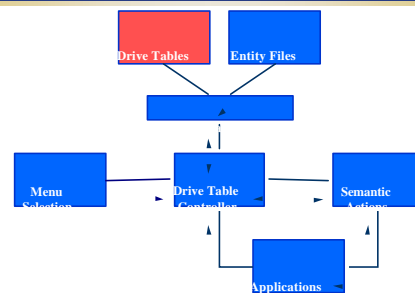
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- address
- all
- applic
- change
- code
- date
- day
- month
- reason
- resp
- revision
- security
- spalt
- title
- version
- year

All elements used by Drive Tables are specified in a DTD

These elements are part of the DT metadata (contained in the status section) and are parsed by the DTC, but are not used in execution of the DT

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## Status Section

```
<status>
  <address>
    <code>balpars</code>
    <title> &balpars; </title>
  </address>
  <security class="unclassified"/>
  <applic>
    <all/>
  </applic>
  <version>
    <revision>Baseline</revision>
    <change>0</change>
    <reason>Process and transfer BALPARS data. </reason>
    <date>
      <year>2003</year>
      <month>April</month>
      <day>28</day>
    </date>
    <resp>Whit Kemmey K54</resp>
  </version>
</status>
```



- action
- assert
- case
- content
- default
- drivetable
- dt-ref
- else
- elseif
- eq
- equipment
- expression
- ge
- go2step
- gt
- if
- interface
- le
- log
- lt
- mode
- ne
- parameter
- postcond
- precond
- property
- protocol
- sa
- status
- step
- step-alts
- subtask
- subtask-alts
- switch
- task
- task-alts
- then
- value
- wrapup

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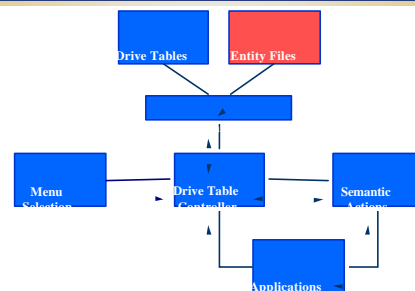
## Content Section

Abort if this equipment is changed

Initialize variables

```
<content icon.num="0">
  <mode>STANDBY </mode>
  <mode>MSLTEST</mode>
  <equipment>MMSS</equipment>
  <interface>
    <property valueType="string">displayOpen</property>
    <value>false</value>
    <property valueType="string">statusMsg</property>
    <value>&balpars.scrollAbort;</value>
    <property valueType="string">completeMessage</property>
    <value>&balpars.complete.no_transfer;</value>
    <property valueType="string">assumeMediaInserted</property>
    <value>false</value>
  </interface>
  <task title="&balpars;">
    <!-- MAIN STEPS -->
```

Allowed modes



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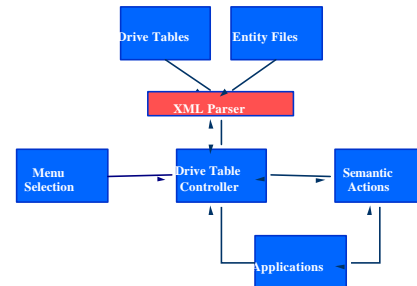
## Entities

```
<ENTITY leapsec "BALPARS">

<ENTITY SUCCESS "0">
<ENTITY DEP_ABORT_DATA "7">
<ENTITY DEP_ABORT_MMSSIO "8">

<ENTITY balpars.init1 "This task will process and transfer BALPARS data and, if
required, prompt for media initialization.">
<ENTITY balpars.init2 "Do you want to continue?">

<ENTITY balpars.abort "Operation aborted.">
<ENTITY balpars.abort.mode_change "Mode change is in progress.">
<ENTITY balpars.abort.mode_fail "Mode was not achieved.">
<ENTITY balpars.abort.mmss "A MMSS failure has occurred.">
```



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## XML Library

- Open source XML parser libxml
- Written in C; source code can be downloaded from the internet at <http://www.xmlsoft.org>
- Uses a DOM-like interface

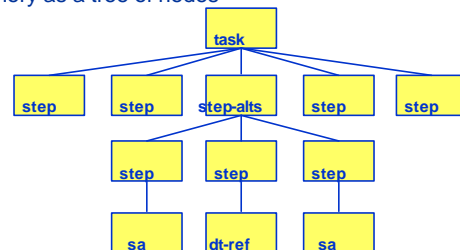
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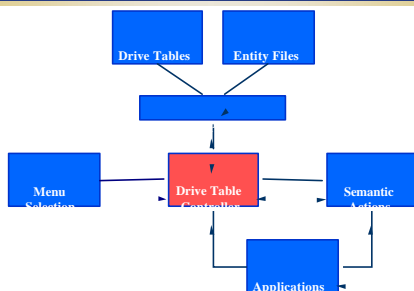
## Drive Table Tree

DT is parsed by XML Parser and then represented in memory as a tree of nodes



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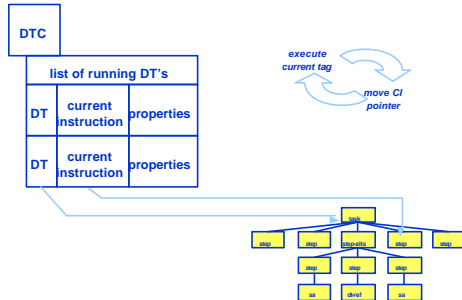


## DTC Design Overview

- Called when operator selects menu items
  - Parameter indicates filename of Drive Table (DT)
- DTC calls XML Parser to load DT into memory as DOM tree
- DTC moves from node to node, executing specified instructions, and deciding which node to execute next based on DT
- DTC calls Semantic Actions (SAs) as instructed by DT
- DTC can execute additional DTs as instructed by DT
- DTC remains responsive to system events

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## X Event Loop

```
dtc_globals->uxTopLevel = XtAppInitialize(...);

dtc_globals->widgetId = fcx_create_msgbox(...);
XtSetMappedWhenManaged(... False);
XtSetMappedWhenManaged(... False);
XtRealizeWidget(...);

XtAddEventHandler(... (XtPointer)dtc_clientMessageCb ...);

xcme.type = ClientMessage;
xcme.window = XtWindow(dtc_globals->trueTopLevel);
xcme.format = 32;
xcme.message_type = 1;

XSendEvent(... (XEvent *)&xcme);

XtAppMainLoop(dtc_globals->uxAppContext);
```



## dtc\_postCond

```
postcondNode = dtc_getCn(dtc_globals->dtStack);

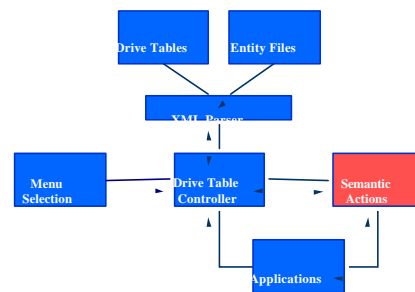
listSize = dtc_countChildrenByName(postcondNode, assert_str);
for (i=0; i < listSize; i++){
    tempn = dtc_nextChild(postcondNode,tempn,assert_str);
    status = dtc_assert(tempn);
    if (status != SUCCESS){
        dtc_goCat(DTC_ERR_POSTCOND);}}

nextNode = postcondNode->next;
if (NULL == nextNode){
    parentNode = postcondNode->parent;
    if (xmlStrcmp(parentNode->name, step_str) == 0){
        nextNode = dtc_fromStepToNextExecutable(parentNode);}}
dtc_setCn(dtc_globals->dtStack, nextNode);

dtc_sendEvent();
```

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## Semantic Action Overview

- Set of functions with common prototype
- Loaded along with DTC
- Invoked using symbol lookup
  - Char\*\* sa\_name (SaArg \*saArg)
- saArg structure
  - Parameter data from DT as NULL-terminated array
  - Additional information from DTC (e.g., application context)

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## sa\_getChar

```
char **sa_getChar(SaArg *saArg) {
    char **retArray = NULL;

    if (2 == sa_getNumElements(saArg->stringArray)) {
        status = sa_getStringAt(saArg->stringArray, &str, 0);

        if (ERROR != status) {
            status = sa_getLongAt(saArg->stringArray, &index, 1);

            if (ERROR != status) {
                retArray = sa_newStringArray(1);
                if (index >= strlen(str)) {
                    sa_putStringAt(retArray, "error", 0); }
                else {
                    ch[0] = str[index];
                    sa_putStringAt(retArray, ch, 0); }}}

    return retArray;}
```





- sa\_ckUAS determines if UAS is open
- sa\_launchUAS launches UAS from the specified Mass Memory
- sa\_isMMSSavailable provides the status of the "other" Mass Memory
- sa\_launchApp launches an application
- sa\_whatDESSamI provides the node number of the DESS
- sa\_wrapupApp terminates a previously launched application and unloads the associated program set
- sa\_getChar returns a single character from a string
- sa\_increment increments a given integer
- sa\_concatenate takes two strings and returns the string
- sa\_autolog posts a message to the autolog
- sa\_ckDessConfig checks status of specified DESS

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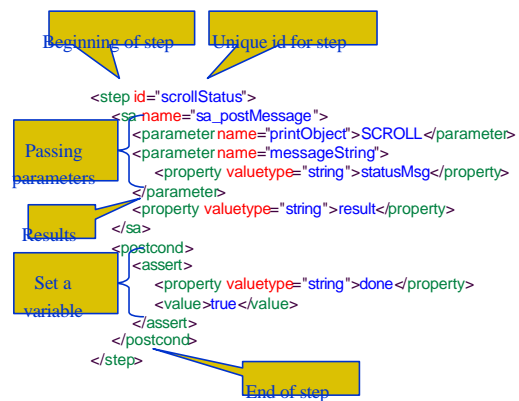
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## Content Section

```
<content icon.num="0">
  <mode>STANDBY</mode>
  <mode>MSLTEST</mode>
  <equipment>MMSS</equipment>
  <interface>
    <property valueType="string">displayOpen</property>
    <value>false</value>
    <property valueType="string">statusMsg</property>
    <value>&balpars.scroll.abort</value>
    <property valueType="string">completeMessage</property>
    <value>&balpars.complete.no_transfer</value>
    <property valueType="string">assumeMediaInserted</property>
    <value>false</value>
  </interface>
  <task title="&balpars;">
  <!-- MAIN STEPS-->

```



## If

```
<if>
  <expression>
    <property valueType="string">dte.abort</property>
    <eq/>
    <value>true</value>
  </expression>
  <then>
    <action>
      <go2step stepref="initResponse"/>
    </action>
  </then>
</if>
```

```
if (dte_abort == TRUE)
{
  goto initResponse;
}
```



```
ifNode = dte_getCn(dte_globals->dteStack);

actionNode = dte_getActionNodeIfTrue(ifNode);

if (NULL == actionNode){ /* check <elseif>'s */
  listSize = dte_countChildrenByName(ifNode, elseif_str);
  for (i = 0; (i < listSize) && (NULL == actionNode); i++){
    elseifNode = dte_nextChild(ifNode, elseifNode, elseif_str);
    actionNode = dte_getActionNodeIfTrue(elseifNode);}}

if (NULL == actionNode){ /* check for <else> */
  elseNode = dte_nextChild (ifNode, elseNode, else_str);
  if (NULL != elseNode) actionNode = elseNode->children;}

if (NULL != actionNode) status = dte_action(actionNode);
if(status == SUCCESS) status = dte_setIfSwitchNextNode(ifNode);
if(status == SUCCESS) dte_sendEvent();
```

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```

<switch>
  <property valueType="string">thisDess</property>
  <case><value>1</value>
    <action>
      <assert>
        <property valueType="string">otherDess</property>
        <value>2</value>
      </assert>
    </action>
  </case>
  <case><value>2</value>
    <action>
      <assert>
        <property valueType="string">otherDess</property>
        <value>1</value>
      </assert>
    </action>
  </case>
</switch>

```

```

switch (thisDess)
{
  case 1:
    otherDess := 2;
    break;
  case 2:
    otherDess := 1;
}

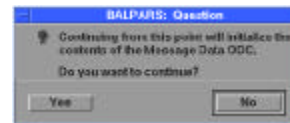
```



```

<step id="initialize">
  <sa name="sa_postDisplay">
    <parameter name="TitleText">&balpars</parameter>
    <parameter name="TemplateType">Question</parameter>
    <parameter name="SystemModal">NO</parameter>
    <parameter name="NumButtons">2</parameter>
    <parameter name="NumWidgets">3</parameter>
    <parameter name="Pushbutton1">YES</parameter>
    <parameter name="Pushbutton2">NO</parameter>
    <parameter name="WidgetID">PIXMAP_WIDGET</parameter>
    <parameter name="Pixmap">Question</parameter>
    <parameter name="Text1">TEXT_STRING_WIDGET</parameter>
    <parameter name="String1">
      <property valueType="string">initializeMsg</property>
    </parameter>
    <property valueType="string">windowID</property>
  </sa>
  <postcond>
    <assert>
      <property valueType="string">displayOpen</property>
      <value>true</value>
    </assert>
  </postcond>
</step>

```



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```

<step id="initResponse">
  <sa name="sa_getResponse">
    <parameter name="windowID">
      <property valueType="string">windowID</property>
    </parameter>
    <parameter name="numRegionOneCheckBoxes">0</parameter>
    <parameter name="numRegionTwoCheckBoxes">0</parameter>
    <property valueType="string">buttonSelected</property>
    <property valueType="string">firstScrollRegion</property>
    <property valueType="string">secondScrollRegion</property>
  </sa>
  <switch>
    <property valueType="string">buttonSelected</property>
    <case>
      <value>YES</value>
      <action><go2step stepref="initRemove"/></action>
    </case>
    <case>
      <value>NO</value>
      <action><go2step stepref="finalRemove"/></action>
    </case>
  </switch>
</step>

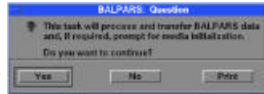
```



```

<drivetable>
  <status></status>
  <content icon.num="0">
    <mode>STANDBY</mode>
    <equipment>MMSS</equipment>
    <interface></interface>
    <task title="&balpars;">
      <!-- MAIN STEPS -->
      <step id="init"></step>
      <step id="initResponse"></step>
      <step id="initPrint"></step>
      <step id="initRemove"></step>
      <step id="checkMode"></step>
      <step id="callChangeMode"></step>
      <step id="mtfss"></step>
      <step id="mtfssResponse"></step>
      <step id="mtfssRemove"></step>
      <step id="launchProcessBaltars"></step>
      <step id="getAltMmssStatus"></step>
      <step id="getDess1Config"></step>
      <step id="getDess2Config"></step>
      <step id="launchTransferBaltars"></step>

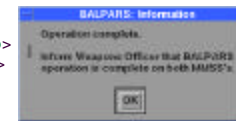
```



```

<step id="initialize"></step>
<step id="initializeResponse"></step>
<step id="initializeRemove"></step>
<step id="launchInitialize"></step>
<!-- SUBROUTINES -->
<!-- abort -->
<step-alts id="abort"></step-alts>
<!-- printouts and complete -->
<step id="printouts"></step>
<step id="printoutsResponse"></step>
<step id="printoutsRemove"></step>
<step id="complete"></step>
<!-- finalResponse -->
<step id="finalResponse"></step>
<!-- W R A P U P -->
<wrapup>
  <step id="finalRemove"></step>
  <step id="scrollStatus"></step>
</wrapup>
</task>
</content>
</drivetable>

```



## NAVSEA Summary of Benefits

- Easy to modify and extend
  - Change or add Drive Tables
  - Add SAs that anyone can use
  - New features
- Multi-purpose XML
  - Generate documentation
  - Convert to HTML via XSL for testing
  - Incorporate into Content Management system for configuration control

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## NAVSEA Customer Perspective

- Simplify execution of procedures
  - Direct actions of operator
  - Account for configuration
  - Reduce reliance on paper
  - Reduce number of actions required

Previous # of Steps	Current # of Steps
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- IMPROVE QUALITY OF LIFE OF THE SAILOR!

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