Nuclear Plant Analyzer

Installation Manual

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ABSTRACT

This report contains the installation instructions for the Nuclear Plant Analyzer (NPA) System. The NPA System consists of the Computer Visual System (CVS) program, the NPA libraries, the associated utility programs. The NPA was developed at the Idaho National Engineering Laboratory under the sponsorship of the U.S. Nuclear Regulatory Commission to provide a highly flexible graphical user interface for displaying the results of these analysis codes. The NPA also provides the user with a convenient means of interactively controlling the host program through user-defined pop-up menus. The NPA was designed to serve primarily as an analysis tool. After a brief introduction to the Computer Visual System and the NPA, an analyst can quickly create a simple picture or set of pictures to aide in the study of a particular phenomenon. These pictures can range from simple collections of square boxes and straight lines to complex representations of emergency response information displays.

FIN L1586—Accident Management NPA
FIN W6238—Code Maintenance—RELAP5 and NPA

 

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Nuclear Plant Analyzer

Volume 1: Installation Manual

1. INTRODUCTION

The Nuclear Plant Analyzer (NPA) System is composed of two major code segments—the NPA libraries and the CVS program. The installation tape supplied with the software transmittal contains the source code and UNIX scripts required to compile the NPA System on a wide range of target computers. This manual provides the instructions for installation and testing of the NPA System. The reference manuals for the NPA¹ and CVS² programs are also provided on the installation tape in Postscript format.

Table 1 contains the list of supported platforms for the NPA System, along with the directory names used in the installation scripts to build the executable binaries for each machine type.

Although emphasis is placed on installation of the software on the targeted computer systems, the software has been designed to be easily ported to other UNIX platforms supporting the X11 windowing interface.

The NPA System software is distributed in the UNIX compressed tar format. Use of the tar utility maintains the NPA System directory structure (Figure 1) that is necessary to build libraries and programs from source files. In the installation process, you will be asked to enter the directory path where the NPA System will be loaded. Throughout this manual, the path you enter will be referenced by the mnemonic *[path]*..

Table 1. List of supported platforms.

Machine type/operating system	Directory name
Digital Equipment Corp. DECstations/ULTRIX	DEC_ULTRIX
Digital Equipment Corp. DECstations/OSF1	DEC_OSF1
Digital Equipment Corp. VAXstations/ULTRIX	VAX_ULTRIX
Hewlett Packard Series 700 computers/HP-UX	HP_UX
International Business Machines Risc 6000 Series/AIX	IBM_AIX
Silicon Graphics Corp. IRIS computers/IRIX	SGI_IRIX
Stardent (Kubota Pacific Computer Titan Series)/UNIX	STARDENT
Sun Microsystems Sparc Stations/SUN-OS	SUN_OS

Figure 1. NPA System distribution directory structure.

2. INSTALLATION

This section provides the instructions for installing the NPA System. Table 2 lists the minimum system requirements for installing and executing the NPA System software. Significantly more disk space may be required during execution, depending on the requirements of the host program. If a single disk is to be used to load and build the NPA in a heterogeneous network environment, the required disk space increases by approximately 30 MB for each set of executable binaries created.

It should be noted that the versions of compilers, linkers, and system libraries used for software development may differ from those available on your system. Installation problems are most often related to changes in the operating system and compilers and can be corrected with minor changes to the compiler options defined for a particular machine.

The installation scripts require the user to be running under the C Shell. If you are not sure which shell you are using, use the `ps` utility to find out. It will show that you are running `cs`h (C Shell), `sh` (Bourne Shell), or `ksh` (Korn Shell). If you are not already running under the C Shell you can execute the C Shell by giving the command `cs`h.

2.1 Loading the NPA System Software

The NPA System software is distributed in the UNIX compressed `tar` format. The `tar` format maintains the directory structure that is necessary to build libraries and programs from source files while compression reduces the physical size of the distribution file. The steps required to reconstruct the directory structure from the compressed `tar` file are as follows:

1. Create the directory where the NPA System software is to be loaded, if it does not already exist, by entering the command:
`mkdir [path]`
2. Change to the NPA System directory:
`cd [path]`
3. If the compressed `tar` file is on tape, place the tape in the tape drive and enter the command:
`dd if=/dev/rmt0h | uncompress | tar -xvf - .`

Table 2. System requirements.

System requirement	Installation	Execution
UNIX Operating System	x	x
X11-Window System	x	x
FORTTRAN-77 Compiler	x	—
ANSI C Compiler	x	—
40 MB free disk space	x	x
Postscript printer	x	x

`/dev/rmt0h` is the name Digital Equipment Corporation uses for their TK tape drive. Replace this name with the device applicable to your machine. The `v` argument instructs the `tar` utility to display the name of each file as it is extracted. When additional arguments to the `dd` utility are required for a particular platform, they will be supplied with the media.

4. If the compressed `tar` file is on disk, enter the command:

```
zcat NPAsys.tar.Z | tar -xvf -
```

`NPAsys.tar.Z` is the default name for the compressed `tar` file. If the name is different or if the file is not in the `[path]` directory, substitute the correct pathname for the file in the preceding command.

2.2 Printing NPA Documentation

Documentation for the NPA System is provided in three subdirectories under the `[path]/doc` directory. The subdirectory `release_notes` contains release notes for the current release of the system. Both ASCII and Postscript forms of the release notes are provided. Users are urged to read this information whenever a new version of the NPA System is installed.

Another subdirectory `man-pages` contains instructions for the use of various NPA processes in UNIX man page form. The files are in ASCII or Postscript format as indicated by the filename extensions.

The third subdirectory `manuals` contains files for the NPA System manuals in Postscript format. The files are listed in Table 3. Because of the size of some of the manuals, users may prefer to view them online and print only selected pages rather than the entire manual.

2.3 Heterogeneous Network Installation

The NPA installation scripts are designed to accommodate the building of the NPA System binaries on a heterogeneous network of workstations. Specifically, you may load the NPA System software on a single workstation's disk, mount that disk on other workstations on the network, and build the NPA System binaries for each different type of workstation using that mounted disk. There is no longer a need to load or copy the NPA System software to each individual platform in order to build the binaries for that platform. The installation scripts accomplish this by creating a separate directory structure under `[path]` to be used in building the binaries for the type of workstation that is executing the installation. For example, execution of the install script on a DEC 5000 workstation will create a directory named "DEC_ULTRIX", link the

Table 3. NPA manual files and approximate number of pages.

Manual name	Filename	Number of pages
NPA Installation Manual	install.ps	28
NPA Reference Manual	NPA_ref.ps	73
CVS Reference Manual	CVS_ref.ps	131
NPA Programmer's Manual	Prgmr.ps	193

required source and script files to that directory structure, and build the binaries under that directory. Similarly, installation on an IBM RS/6000 will create and use a directory named "IBM_AIX". The build directory pathnames for the currently supported platforms are listed in Table 1. Throughout this manual, this directory will be referenced by the mnemonic *[machine]*.

2.4 Building the NPA System for a Supported Platform

To build the NPA system on a supported platform, simply change to the NPA System directory *[path]* and enter the command **install**. If the NPA System software was loaded on a different platform on a local network, it may be necessary to have a system administrator mount the remote file system before you can access the NPA System directory.

The installation scripts will create the appropriate *[machine]* directory, populate it by linking files from the original load directories, and build the required binary files. The structure of the *[machine]* directory after a successful installation is described in Section 3.

The executable binaries and scripts of interest to NPA users are located in the *[machine]/bin* directory. Users are encouraged to add this directory to their UNIX shell *path* variable.

The installation scripts also create a pair of log files that document the operations performed during the installation. The installation log files for the NPA and CVS installations are named *[machine]/npa/Install.log* and *[machine]/cvs/Install.log*, respectively. The installer is encouraged to review these files to ensure that all of the steps are completed successfully. If problems are encountered, information in the log files will be used to locate and correct the errors.

2.5 Building the NPA System on a New Platform

Experience has shown that each platform and operating system is likely to have a unique set of compiler and loader flags that are required for building the NPA System. The installation scripts are designed to isolate the platform-specific parameters in two shell scripts that are used to invoke **make**. The scripts for the supported platforms are stored in the *[path]/{cvs, npa}/util/[machine]* directories with the names **make_lib** and **make_pgm** for building the library and program directories, respectively. (These files are generally identical in the **npa** and **cvs** directories.) This scheme for dealing with platform-dependencies allows a single makefile in each source directory in the NPA System to be used on all of the platforms. Therefore, a user porting the NPA system to a new platform should not need to edit any makefiles. Doing so will probably result in errors if an install is attempted on a supported platform. Instead, the user is encouraged to create new *[machine]* directories under *[path]/{cvs, npa}/util*, copy the **make_lib** and **make_pgm** scripts from one of the supported platform directories, and modify the scripts as required. The basic structure of the scripts is shown in the list of the *[path]/npa/util/HP_UX/make_pgm* script that follows:

```
#!/bin/csh -f
#
#   make_pgm - script to run ../../util/makePG for a program
#
if ( $1 == debug ) then
    set CC2 = '-Aa -g -Dhp700 -D_HPUX_SOURCE -DERDS -I/usr/include/
    X11R5 -L/usr/lib/X11R5'
```

Installation

```
set FF2 = '-g +ppu'
shift
else
set CC2 = '-Aa -Dhp700 -D_HPUX_SOURCE -DERDS -I/usr/include/X11R5
-L/usr/lib/X11R5'
set FF2 = '+ppu' set CC2 = 'echo CC2='$CC2''
endif
set CC = cc
set FF = f77
set LL2 = -lm
set DEF = hp700
#
set CC = 'echo CC=$CC'
set CC2 = 'echo CC2=\"$CC2\"'
set FF = 'echo FF=$FF'
set FF2 = 'echo FF2=\"$FF2\"'
set LL2 = 'echo LL2=\"$LL2\"'
set DEF = 'echo DEF=\"$DEF\"'
../util/makePG $* $CC $CC2 $FF $FF2 $LL2 $DEF
```

The user should modify the script to insert values suitable for the new machine. Set CC to the name of the C compiler. Set CC2 to the C compiler directives. The name of the FORTRAN compiler is set into FF. FF2 is set to the FORTRAN compiler directives. Set LL2 to the desired linker directives. DEF is set to the machine name. It is used by a FORTRAN preprocessor to tailor code to a specific machine. In the C compiler directives, the -D argument serves the same purpose.

Some platforms exhibit idiosyncracies which cannot be effectively handled by passing parameters to the make utility. The installation scripts are designed to deal with these special circumstances by invoking the scripts `[path]/{cvs,npa}/util/[machine]/quirks/install`, if they exist. All additional files used by these special install scripts are also stored in the quirks directory. An example of a quirks directory can be found at `[path]/npa/util/HP_UX/quirks`. If a user porting the NPA System to a new platform encounters difficulties that can not be resolved through passing parameters to the make utility, it may be necessary to create a quirks directory and quirks/install script. There is no quirks directory for a platform that do not exhibit idiosyncracies.

When the new make scripts have been installed in the `[path]/{cvs,npa}/util/new_machine` directories, the script `[path]/install` can be invoked with the name of the `[machine]` directory as a argument, as in:

```
cd [path]
```

```
install new_machine
```

The `[path]/install` script can be modified so that the new platform is recognized and the `[machine]` directory name set automatically. The `[path]/install` script can then be invoked without the argument to build the NPA System on the new platform.

2.6 Load the NPA Fonts

The NPA and CVS fonts are located in the `[machine]/npa/fonts` and `[machine]/cvs/fonts` directories, respectively. Users may access the font files directly from those directories by setting the appropriate font path variables in the NPA and CVS setup files. See References 1 and 2, respectively. Alternatively, the font files may be copied to the default directories, `/usr/local/npa/fnt` and `/usr/local/npa/aux` for the NPA

and CVS font files, respectively. It may be necessary to ask a system administrator to perform these copies because the `/usr/local` directory is generally only writable by the superuser. The required commands are:

Create the `/usr/local/npa`, `/usr/local/npa/aux`, and `/usr/local/npa/fnt` directories, if they do not already exist.

```
mkdir /usr/local/npa /usr/local/npa/{aux,fnt}
```

Copy the NPA fonts to the directory `/usr/local/npa/fnt`.

```
cd [machine]/npa/fonts
```

```
cp * /usr/local/npa/fnt
```

Copy the CVS fonts and color table to the directory `/usr/local/npa/aux`.

```
cd [machine]/cvb/fonts
```

```
cp * /usr/local/npa/aux
```

2.7 Linking NPA to a New Program

The linking of the NPA to a new program is described in the NPA Reference Manual (Reference1). The `replay.f` file, located in the `[path]/npa/src/replay` directory, provides an example of using the NPA interface with a FORTRAN program. The `PMake` file contained in this directory shows the libraries needed by the linker to create an executable. The `suite.c` file located in the `[path]/npa/src/suite` directory provides an example of using the NPA interface with a C program.

2.8 Testing the NPA System Installation

1. To test the NPA installation, change directories:

```
cd [machine]/demo/suite
```

The following script executes the NPA suite test program. It assumes you are seated at the executing workstation and not logged in from a remote workstation.

```
run
```

The following script also executes the NPA suite test program driven by the suite test program and illustrates some of the dynamic functions typically used for severe accident displays. It assumes you are seated at the executing workstation and not logged in from a remote workstation.

```
run2
```

2. To test the RELAP5/NPA System, RELAP5³ must first be installed and linked to the NPA libraries. Follow the instructions provided with the RELAP5 transmittal for installation of RELAP5 with the NPA option activated. Set the variables `$RELAP` and `$TPFH2O` to the full paths to the RELAP5 executable and water property files, respectively.

```
set RELAP = [relappath]/relap5.x
```

```
set TPFH2O = [relappath]/tpfh2o
```


Installation

These can be set in your \$HOME/.login or \$HOME/.cshrc file to simplify execution of RELAP5.

Two sample RELAP5 cases are provided with the NPA System transmittal tape. The first case is an Edward's pipe problem executed by changing to the edpipe directory and using the run script:

```
cd [machine]/demo/edpipe
```

```
run
```

The second RELAP5 test case consists of a typical pressurized water reactor model. Change to the typpwr directory and execute the run script:

```
cd [machine]/demo/typpwr
```

```
run
```

3. DIRECTORIES AND FILES

Figure 2 illustrates the structure of the *[machine]* directory after a successful build of the NPA System. The contents of each of the main subdirectories are discussed in this section.

Figure 2. NPA System *[machine]* directory structure.

3.1 Subdirectories in *[machine]*

3.1.1 The *[machine]/bin* Subdirectory

The **bin** directory contains executable programs and shell scripts for the NPA System user. These executable programs are specific to the architecture of the computer on which they were built and will only execute on computers that are binary-compatible with that platform.

cvs	The cvs program.
replay	Replay data in the NPA internal format.
suite	A test program that demonstrates some NPA display features.
dls2a	The dls2a utility program transforms the CVS display list file (<i>dls</i> file) to an ASCII form. The ASCII file (<i>dla</i> file) is portable between brands of computers.
dla2s	The dla2s utility program transforms an ASCII <i>dla</i> file to a CVS display list file (<i>dls</i> file). The ASCII <i>dla</i> file is portable between brands of computers while the <i>dls</i> file is particular to a computer.
NPA2x	Converts a NPA binary data file to xdr format. This is the first step in transferring an NPA dat file to a different computer.
x2NPA	Converts a xdr format NPA data file to the native binary format. This is the final step in transferring an NPA data file to a different computer.
r2NPA	Create an NPA data file using data frames from a RELAP5 restart/plot file.
dfiChn	Extract data channels from an NPA data file.
dfiFrm	Extract an entire data frame from an NPA data file.
NPA2xy	Extract a data channel from an NPA data file into an ASCII, x-y pairs, data file suitable for input to generic plotting programs.
NPA2pro	Extract values for a specified series of data channels at a specified time into an ASCII, x-y pairs, data file where the x-values are arbitrarily assigned.
fix.cvenv	Add the appropriate font directory specification to the .cvenv file.
fix.paenv	Add the appropriate font directory specification to the .paenv file.
reW	A script to toggle between the Digital Equipment Corp. dxwm window manager and the uwm window manager.
sw_wm	A script to select between the four popular window managers.
killW	A script to kill the window manager process.
restartW	A script to restart the window manager process.
clean	A script to remove the *.log, *.err, trace, and scratch files created by some NPA processes.

3.2 Subdirectories in *[machine]/npa*

3.2.1 The *npa/fonts* Subdirectory

The **fonts** subdirectory contains the binary font files that are used during NPA execution on this platform. If the files have been copied to another location, such as */usr/local/npa/fnt*, they could be removed from this location.

3.2.2 The *npa/lib* Subdirectory

The **lib** subdirectory contains the NPA libraries. They were used in building the NPA executable binaries found in the *[machine]/bin* directory. If an analysis program, such as RELAP5, is to be linked to

the NPA, each library in this directory must be included in the link step used to build the executable program. If the NPA is not being linked to a simulation code and recompilation of the NPA executables is unlikely, some disk space can be recovered by removing these files.

3.2.3 The npa/src Subdirectory

The **src** subdirectory contains the NPA program source and header files. Each subdirectory contains a **makefile**, used by the **make** utility to build its library or program. The source code in these directories has been linked from the *[path]/npa/src* directories. After all NPA binaries have been built successfully, some disk space can be recovered by removing all *.o files.

3.2.4 The npa/util Subdirectory

The utility subdirectory **util** contains scripts for compiling and maintenance of the NPA. These files will be needed if any recompilation of the programs or libraries is anticipated.

3.3 Subdirectories in *[machine]/cvs*

3.3.1 The cvs/fonts Subdirectory

The **fonts** subdirectory contains the binary font and color table files that are used during CVS execution on this platform. If the files have been copied to another location, such as */usr/local/npa/aux*, they could be removed from this location.

3.3.2 The cvs/lib Subdirectory

The **lib** subdirectory contains the CVS libraries. They were used in building the CVS executable binaries found in the *[machine]/bin* directory. If the recompilation of the CVS executables is unlikely, some disk space can be recovered by removing these files.

3.3.3 The cvs/src Subdirectory

The **src** subdirectory contains the CVS program source and header files. Each subdirectory contains a **makefile**, used by the **make** utility to build its library or program. The source code in these directories has been linked from the *[path]/cvs/src* directories. After all CVS binaries have been built successfully, some disk space can be recovered by removing all *.o files.

3.3.4 The cvs/util Subdirectory

The utility subdirectory **util** contains scripts for compiling and maintenance of CVS. These files will be needed if any recompilation of the programs or libraries is anticipated.

3.4 Subdirectories in *[machine]/demo*

The directory *[machine]/demo* contains demonstration directories. Each directory contains a NPA dynamic function driver file and mask (drawing) files. Since the binary (machine-specific) mask files will be created in these directories, the *.pax and *.dla files were linked from the *[path]/demo* directory. If the demonstration programs are not required, these directories can be removed.

Directories and Files

3.4.1 The demo/suite Subdirectory

The **suite** subdirectory contains two examples that demonstrate the NPA System using the suite test program.

3.4.2 The demo/edpipe Subdirectory

The **edpipe** subdirectory contains a RELAP5 Edward's pipe test problem. RELAP5 must be installed and linked to the NPA in order to exercise this test case.

3.4.3 The demo/typpwr Subdirectory

The **typpwr** subdirectory contains a RELAP5 typical PWR test problem. RELAP5 must be installed and linked to the NPA in order to exercise this test case.

4. INSTALLING r2xdr ON A CRAY

In some cases, it may be desirable to run the RELAP5 program on a Cray computer in a batch mode and then transfer the data to a workstation to analyze the results using the replay program. This capability is provided in the NPA System through a set of utility programs, as illustrated in Figure 3. The utility program **r2xdr** converts RELAP5 restart/plot data from Cray binary to an "xdr" format. The restart/plot data can then be moved to the workstation, and the "xdr" file is converted to an NPA data file in the workstations native binary format using **x2NPA**.

The NPA Reference Manual¹ gives a description of the use of the **r2xdr** command. The following are the steps required to install the **r2xdr** program on the Cray computer. The NPA installation must previously have been completed. It is assumed that the Cray is linked to the workstation through Ethernet and that the **hosts** and **.rhosts** files are present and correct on both the workstation and the Cray. The procedure for installing **r2xdr** is:

1. Login to your Cray.
2. Make a home directory for the npa and the src subdirectory on the Cray.

```
cd [dir]
```

```
mkdir npa
```

```
cd npa
```

```
mkdir src
```

```
cd src
```

3. Move the include directory from the workstation to the Cray.

```
rcp -r wrks:[path]/npa/src/include .
```

In this example, the NPA is assumed to be on the workstation with the internet address of "*wrks*".

Figure 3. Cray file transfer.

Installing r2xdr on a Cray

4. Move the r2xdr directory from the workstation to the Cray.

```
rcp -r wrks:[path]/npa/src/r2xdr .
```

5. Move four files from the workstation dfi directory to the Cray.

```
cd r2xdr
```

```
rcp wrks:[path]/npa/src/dfi/dfiErr.c .
```

```
rcp wrks:[path]/npa/src/dfi/dfiWrt.c .
```

```
rcp wrks:[path]/npa/src/dfi/xdrDFI.c .
```

```
rcp wrks:[path]/npa/src/dfi/xdrWrt.c .
```

6. While in the r2xdr directory, compile and link r2xdr.

```
Cmake
```

This completes the installation of r2xdr.

5. SUITE

The **suite** program is similar to an analysis program except that the data produced to drive the NPA are dummy data. Executing the **suite** program provides a useful check for proper installation of the NPA System. The program is also useful for testing results when programing new dynamic functions in CVS. The source code for **suite**, contained in the *[path]/npa/src/suite* directory, serves as an example for interfacing the NPA System to host programs written in the C language.

The dummy data names and data ranges generated by **suite** are listed in Table 4.

The executable for **suite** resides in the directory *[machine]/bin*. A sample drawing file in ASCII format (examp.dla) and an analyzer file (examp.pax) are contained in the directory *[machine]/demo*. To run the sample case for the **suite** program, the ASCII drawing file must first be converted to binary format using the following command:

[machine]/bin/dla2s examp

Table 4. Dummy data names and ranges in **suite**.

Channel name	Minimum value	Maximum value
time	-10	—
n10	0	10
n100	0	100
n10	0	2000
n-10	-10	10
n-100	-100	100
n-2000	-2000	2000
void	0	1
tf	0	1200
tg	0	1300
tsat	0	1200
sin1	-1	1
sin2	-10	10
sin3	1	3
bes1	-10	10
bes2	-10	10
rand	-1.E9	1.E9
reg9	0	9
atan1	0	1
atan2	0	1
atan3	0	1
radfo	0	0.8
radci	0	1.1
radco	0	1.3
damlev	0	1

Suite

This will create a file, **examp.dls**, which can be read by the NPA or modified by CVS. The following command can be used to execute the sample case:

[machine]/bin/suite -p examp

The individual data channels may be plotted from the NPA.

6. REFERENCES

1. D. M. Snider et al., *Nuclear Plant Analyzer (NPA) Reference Manual*, EGG-EAST-9095, Revision 1, August 1992.
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11. ABSTRACT (200 words or less)

This report contains the installation instructions for the Nuclear Plant Analyzer (NPA) System. The NPA System consists of the Computer Visual System (CVS) program, the NPA libraries, the associated utility programs. The NPA was developed at the Idaho National Engineering Laboratory under the sponsorship of the U.S. Nuclear Regulatory Commission to provide a highly flexible graphical user interface for displaying the results of these analysis codes. The NPA also provides the user with a convenient means of interactively controlling the host program through user-defined pop-up menus. The NPA was designed to serve primarily as an analysis tool. After a brief introduction to the Computer Visual System and the NPA, an analyst can quickly create a simple picture or set of pictures to aide in the study of a particular phenomenon. These pictures can range from simple collections of square boxes and straight lines to complex representations of emergency response information displays.

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