10.4 TOOLS AND SERVICING EQUIPMENT

10.4.1 Introduction

All tools and servicing equipment necessary to meet the reactor general servicing requirements are supplied for efficiency and safe serviceability with a minimum of time. Table 10.4.1 is a listing of tools and servicing equipment supplied with the nuclear system. The following paragraphs describe the use of some of the major tools and servicing equipment.

10.4.2 Fuel Servicing Equipment

Two fuel preparation machines are located in each spent fuel storage pool. These machines are designed to be removed from the pool for servicing.

An equipment support railing is provided around the pool periphery in order to tie off miscellaneous equipment such as the fuel leak detector (sipper) and service tools. The fuel leak detector is used to locate fuel assemblies with perforated fuel pins by sampling water directly from the fuel assembly. Equipment lugs fabricated as part of the pool liner are provided for fixtures that might later be desired by plant operating personnel. In addition, a 4 x 4-inch curb with a 4-inch wide plate of 1-inch thick stainless steel on top is provided around the entire periphery of the refueling volume. Additional equipment may be mounted by welding to, or drilling into the plate. The curb may be used as an additional support or tie-off area. Cable ways are recessed into the floor around the pool periphery with openings to pass cables into the pool from underneath this curbing.

Two new fuel inspection stands are provided near the fuel storage pools on the operating floor to restrain the fuel assembly in vertical position for inspection. The inspection stand can hold two assemblies. The general purpose grapple is a small, hand-actuated tool used generally with fuel. The grapple can be attached to the reactor building auxiliary hoist, jib crane, and the auxiliary hoists on the refueling platform. The general purpose grapple is used to remove new fuel from the shipping containers or the vault, place it in the inspection stand, and transfer it to the fuel pool. It also can be used to shuffle fuel in the pool and to handle fuel during channeling.

A channel handling boom with a spring loaded takeup reel can be used to assist the operator in supporting the channel after it is removed from the fuel assembly and placed in channel storage rack. The boom is set between the two fuel preparation machines. With the channel handling tool attached to the reel, the channel may be conveniently moved between fuel preparation machines.

The complete channeling procedure is as follows. Using one of the jib cranes mounted in the area and the general purpose grapple, a spent fuel assembly is lifted into the fuel preparation machine with the carriage lowered. After raising the assembly to its high position, the channel is unbolted from the fuel assembly using the channel bolt wrench. This wrench guides on the channel, and is used to unscrew the bolt and capture it. The channel handling tool is attached to the channel handling boom and lowered to the channel. The tool is attached to the channel dog ears by expanding two fingers on the tool. The channel is then held, and the fuel preparation machine carriage is lowered causing the fuel assembly to slide down out of the channel. The channel will be placed back on the assembly after the inspection or will be replaced with a new channel if found to be damaged. A channel storage rack for accumulating channels is located on the wall between the fuel preparation machines. The channeled fuel is then stored in the pool storage racks ready for insertion in the reactor.

The preceding description is historically accurate and describes the original intent to reuse channels. More recently, Browns Ferry has committed not to use channels for a second bundle lifetime due to channel bow concerns (reference letter to NRC, "Browns Ferry (BFN) - Units 1, 2, and 3 - Response to NRC Bulletin 90-02 - Loss of Thermal Margin Caused by Channel Box Bow," L44900424802).

10.4.3 Servicing Aids

General area underwater lights are provided with a suitable reflector for general downward illumination. Suitable light support brackets are furnished to support the lights in the reactor vessel, allowing the light to be positioned over the area being serviced independent of the platform. Local area underwater lights are small diameter lights for additional downward illumination. Drop lights are lamps with no reflector, and are used for intense radial illumination where needed. These lights are small enough in diameter to fit into fuel channels or control blade guide tubes. A portable underwater television camera and monitor are part of the plant optical aids. The transmitted image can be viewed on the refueling platform. This remote display assists in the inspection of the vessel internals and general underwater surveillance in the reactor vessel and fuel storage pool. A general purpose, clear plastic viewing aid that will float is used to break the water surface for better visibility.

A portable underwater vacuum cleaner is provided to assist in removing crud and miscellaneous objects from the pool floor, or the reactor vessel. The pump and the filter unit are completely submersible for extended periods. Fuel pool tool accessories are also provided to meet the servicing requirements.

10.4.4 Reactor Vessel Servicing Equipment

Reactor vessel servicing equipment is supplied for safe handling of the vessel head and its components, including nuts, studs, bushings, and seals.

A head strongback is used for lifting the drywell head. The strongback is designed to keep the head level during lifting and transport. Cruciform in shape, with four equally spaced lifting points, the strongback is designed so that no single component failure would cause the load to drop or to swing uncontrollably.

The reactor vessel head is serviced and lifted by the reactor head strongback carousel. The carousel is an integrated assembly capable of performing the following functions:

Lifting of the reactor vessel head - The strongback, when suspended from the reactor building crane main hook, will carry the reactor head plus the carousel, tensioning components, four reactor closure studs, and the removed reactor head nuts and washers stored in the nut storage rack.

Tensioning of reactor head studs - The carousel, when supported on the reactor head lifting lugs, will carry four stud tensioners on a monorail above the reactor/head bolt circle; each tensioner has an electric operated hoist with individual controls. The stud tensioners are hydraulically operated.

Storage with reactor head - The strongback carousel stores with the removed head on the refueling floor pedestals, ready for reinstallation of the head and stud tensioning with nut/washer installation from storage bins in the nut rack.

Storage without the reactor head - When the strongback carousel is not in use, it will be stored on the refueling floor using a special training stand for supporting the lifting rods above the concrete floor.

The head holding pedestals are designed to support the vessel head and strongback/carousel to permit seal replacement and seal surface cleaning and inspection. The mating surface between vessel and pedestal is selected to minimize the possibility of damaging the vessel head.

A reactor servicing platform permits the operator to work at a level just above the reactor vessel flange and permits servicing access for the full core diameter. A service platform support is provided which rests on the vessel flange surface and serves as both a track for the servicing platform, and as a vessel seal surface protector.

A vessel nut handling tool is provided. This tool handles one nut and features a spring loading device to lift the nut and clear the threads.

10.4.5 In Vessel Servicing Equipment

Replacement incore detectors are removed from their shipping container by hand. The instrument handling tool is attached to the incore detector by the operators on the refueling platform. The instrument strongback supports the incore detector until it is in the vessel in a vertical position, then the incore detector is placed in the instrument handling tool mounted on the refueling platform monorail hoist; the strongback is removed; and the LPRM string is lowered into place. Final incore detector insertion is accomplished with the instrument handling tool. The instrument handling tool is used for removing and installing fixed incore detectors as well as handling neutron sources and the Source Range Monitor/Intermediate Range Monitor dry tubes.

In the unlikely event that incore housing flange "O" rings need replacing, an incore guide tube seal and a test plug are provided. The guide tube seal seats when the beveled guide tube enters the vessel from the top. When the drain on the water seal drain assembly is opened, water drains from the incore housing and guide tube; hydrostatic pressure seats the guide tube seal and allows the flange to be removed. The incore guide tube seal contains a bail, similar to the control rod and fuel bail.

10.4.6 Refueling Equipment

One refueling platform is provided for each unit. It is used as the principal means of transporting fuel assemblies back and forth between the reactor well and the storage pool. The platform travels on tracks extending along each side of the reactor well and fuel pool. The platform supports the refueling grapple and auxiliary hoists. The refueling grapple is suspended from a trolley that can traverse the width of the platform.

Platform operations are controlled from a walkway and an operator station on the trolley. The platform contains a Z-axis position-indicating device that indicates the vertical position of the fuel grapple. Horizontal (x and y axis) position indication is available from a manual line-up and sighting system and may be available from a digital display located in the operator's cab. The manual line-up and sighting system involves position marks on the crane that are aligned with positioning marks on a yard stick type device permanently secured to the handrails adjacent to the reactor cavity. The digital display of x and y position, if used, is provided by bridge and trolley position encoders driven by gears which are directly coupled to their respective axis. Where X-Y position is available through encoders, a Programmable Logic Controller (PLC) also maintains three-dimensional operational zone boundary protection. The manual line-up and sighting system and/or the X-Y position display are used to reach the approximate core coordinate locations. Visual inspection by the crane operator and second party verification is used to finalize and actually place the fuel bundle into position.

A single operator is capable of controlling all the motions of the platform required to handle the fuel assemblies during refueling. Interlocks on both the grapple hoist and auxiliary hoists prevent lifting of a fuel assembly over the core with a control rod withdrawn; interlocks also prevent withdrawal of a control rod with a fuel assembly over the core attached to either the fuel grapple or hoists. Interlocks also block travel of the refueling platform over the reactor in the startup mode. The refueling interlocks are described and evaluated in Subsection 7.6, "Refueling Interlocks."

10.4.7 Storage Equipment

In addition to the new and spent fuel storage racks, other storage equipment as listed in Table 10.4-1 is provided.

Defective fuel assemblies may be placed in special fuel cans. Each can is adaptable for individual sipping. For channel removal, the can may be removed from the rack, placed in the fuel preparation machine, the can cover removed, and the channel lifted clear of the fuel assembly. Provisions for dry sipping are provided. This system allows for the detection of leaking fuel rods during refueling and takes place in the fuel pool.

10.4.8 Under Reactor Vessel Servicing Equipment

The necessary equipment to remove control rod drives during a refueling outage is provided. An equipment handling platform with a rectangular open center is provided. This platform is rotatable to provide space under the vessel so the control rod drive can be lowered and removed. Control rod drive handling equipment is used to remove and reinstall control rod drives. A thermal sleeve installation tool is used to rotate the thermal sleeve within the control rod drive housing. Sleeve rotation permits disengagement of the guide tube. A rope and pulley integral with the tool permits complete sleeve removal.

The replacement of fixed incore detectors requires an LPRM nut wrench, spanner tool, wire cutters, and water seal drain assembly. Detector cables are cut as close to the LPRM nut and seal as possible. The nut and seal assembly are removed and a water drain assembly is installed to prevent excessive drainage from the reactor vessel water inventory. The LPRM string assembly is removed from above by refuel floor personnel using the instrument handling tool. The reverse process is used to install a new assembly.

Additional nuclear system tools and servicing equipment are listed in Table 10.4-1.

10.4.9 Storage Pit

Large radioactive components such as the steam dryer and steam separator assembly are stored in the storage pit. The storage pit is separated from the reactor cavity by removable concrete blocks that serve as a shield when the dryer and separator are stored. Other large items, such as the pressure vessel head and drywell head, are stored on the refueling floor.

Because of the relatively low neutron activation dose rates and low crud dose rates, a dry transfer of the dryer is normally expected. To minimize operator exposure during dry transfer of the dryer assembly, the storage pit canal is deep enough so that, if desired, the top of the dryer can be kept at least 2 feet below the operating floor level during transfer (during a dry transfer, portions of the dryer assembly may be above the operating floor level). Wet transfers extend the refueling outage. The storage pit is deep enough below the canal that, with the reactor well drained, a minimum of 6 inches of water shielding can be maintained above the separator plenum dome.

Special liner considerations account for the abrasion and high unit loadings that occur on areas where the dryer and separator assemblies are placed. Provisions are made to control airborne contamination from storage pit walls and equipment during reactor well draindown.

10.4.10 Spent Fuel Shipping Cask Decontamination

Decontamination of spent fuel shipping casks is carried out in a facility located on the El. 664 floor adjacent to the Unit 2 fuel storage pit (Figure 1.6-2). The facility, which is shown in Figure 10.4-7, consists of a housing, a spray nozzle system, a ventilation system, an inspection lift, and means for rotating the cask. This facility serves all three units.

After a loaded shipping cask has been removed from a spent fuel pit with the overhead crane, the cask is moved into position in front of the housing, and the safety cables are removed from between the crane lower block and the cask yoke. The cask is then moved into the housing, the housing door closed, rubber seals placed around the rotator link, the rotator power supply cable connected, and the ventilation system started.

Water for the spray system is delivered by a hydraulic jet unit in which steam and cold water are mixed to produce a hot water stream at elevated pressure. Approximately 50 gpm is delivered to the spray nozzles at a temperature of about 200°F and a pressure of about 330 psig. The system is put into operation at a control panel outside the housing. As the cask rotates, water is sprayed from the top nozzles onto the top of the cask. Thereafter, the water flow is diverted to the

vertical nozzle bank, which is positioned at the top of the cask. After remaining stationary through one or more rotations of the cask, the nozzle bank is lowered about 6 inches and the process is repeated. This continues until the nozzle bank reaches the lower edge of the cask. The water flow then is diverted to the bottom nozzles, which spray the bottom of the cask through a number of cask rotations.

After the spray nozzles have been shut off, an operator enters the housing. Working from the inspection lift, he hand-cleans areas not reached by the spray nozzles. Smears are taken to locate areas that need additional hand cleaning.

A temporary ventilation system is provided to maintain a slight negative pressure within the housing, thereby minimizing outleakage of spray. The temporary system consists of a moisture separator, a HEPA filter and a blower mounted on the top of the housing. The blower has a capacity of approximately 1000 cfm.

Water is drained from the housing to a 15,000-gal cask decontamination tank located in the radwaste building (see paragraph 9.2.4.4). It is expected that about 10,000 gallons will be utilized in the decontamination of a cask.

When decontamination is completed, the cask is moved out of the housing, and the safety cables are replaced.