

# STURGIS



## **MH-1A: World's First Floating Nuclear Power Station**

### **Synopsis**

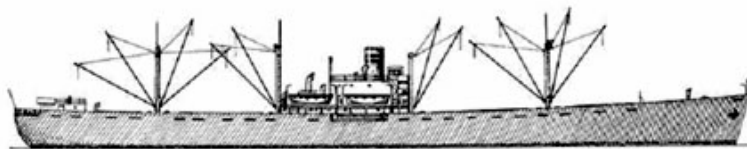
STURGIS was a floating nuclear power station, created in 1963 by the US Army's Corps of Engineers. Its 'foundation' was the modified hull of a World War II Liberty ship. The STURGIS' power source was a pressurized water reactor; designated as MH-1A.

This relatively small nuclear power station generated 10-megawatts of electricity at full power. It was activated in 1967 and provided electrical energy to the Panama Canal Zone between 1968 and 1975. In 1977, it was returned to the United States and deactivated.

Currently, STURGIS is anchored in the James River Reserve Fleet, near Newport News, Virginia. Periodically visited by radiological survey personnel to ensure continued containment of a small amount of radioactive materials remaining onboard, STURGIS is scheduled to be towed to Texas in September 2014 for removal and disposition of residual radioactive waste materials, followed by the scrapping of her hull.

### **SS Charles G. Cugle**

The STURGIS began life as the Liberty ship CHARLES G. CUGLE. Named for an American master mariner who also wrote practical text books pertaining to seamanship and navigation, the SS CHARLES G. CUGLE was one of several Libertys of a modified design. Fitted with larger cargo hatches and heavier lifting gear, she was intended to transport tanks and boxed aircraft in over-sized cargo holds. Otherwise, her dimensions and overall appearance was indistinguishable from her over 2,700 sister ships.



The SS CHARLES G. CUGLE was the 105<sup>th</sup> Liberty ship built by the J.A. Jones Construction Company's Panama City shipyard. Although her construction, from keel to delivery required an elapsed time of only two months and eight days, she was delivered on the last day of August, 1945; too late to serve America in World War II.

Like hundreds of her sister ships, the CHARLES G. CUGLE was placed in a reserve fleet, in case she might be needed in the future for the nation's defense. Many such surplus Liberty ships spent years in what were aptly called idle fleets; only to ultimately be scrapped. But she escaped that fate, when the US Army found a use for her; in large part because of her over-sized cargo holds.

## **ANPP and SM-1**

In the mid-1950's, under the direction of Lieutenant General Samuel D. Sturgis, commanding officer of the Army's Corps of Engineers, that organization began development of a series of small nuclear reactor plants, intended for the supply of electricity and heat at isolated and largely inaccessible military bases that had no supporting infrastructure. Called the Army Nuclear Power Program (ANPP), this little-known activity was headquartered at Ft. Belvoir, Virginia between 1954 and 1977.

Eight reactor plants were developed and deployed by the Corps. Three of them operated, albeit briefly at military bases in Alaska, Greenland and Antarctica. Three others were installed and operated at remote sites in the western United States, including the infamous SL-1 reactor. SL-1 was a prototype boiling water test reactor that was destroyed in a 1961 accident that also claimed the lives of three army operators. While tragic, that accident resulted in a number of 'lessons learned' that benefited the later development of military and commercial reactors worldwide.

The very first Army reactor plant was constructed at Ft. Belvoir. The facility was located in a remote area on the army base, adjacent to Gunston Cove, which served as the reactor's source of cooling water.

SM-1 was a 2-megawatt pressurized water reactor that demonstrated the feasibility of a design that could be factory-manufactured and easily transported to far-off military bases that required a self-contained energy source. Its reactor core was about the size of a domestic dishwasher.



A contract for SM-1 was awarded in December 1954 at a cost of two million dollars. Construction took place between 1955 and 1957. After achieving initial criticality in April 1957, the plant operated in a demonstration phase and supplied small amounts of electricity to a local utility; thus becoming the first reactor plant in America to do so.

For the next sixteen years, SM-1 served as a training reactor for over eight hundred army, navy and air force personnel who qualified there as reactor plant operators. The reactor portion of this facility was shutdown in 1973. Other functions located there continued to operate, and a portion of the building eventually was transformed into a museum.

At some point in the future, currently estimated to be around the year 2030, the SM-1 reactor plant core will be removed and the rest of the reactor plant will be decontaminated and demolished. Until then, a 'restricted access' area surrounding the installation will be maintained and monitored by the Corps.

## **STURGIS (MH-1A)**

The largest of the reactor plants developed by the Corps was mobile, self-contained and had an electrical generating capacity of 10-megawatts. Instead of building a barge, the Corps opted to utilize a surplus Liberty ship. The almost new CHARLES G. CUGLE proved ideal for their purposes. Importantly, she had sufficient room in an over-sized cargo hold for installation of a 350-ton reactor vessel.



A \$17 million contract was awarded in 1961 to Martin Marietta for design and construction of the MH-1A reactor plant. The Corps contracted separately for a turbine generator and associated systems, electrical generating equipment, and for extensive shipboard modification work. Collision protection was provided for the reactor vessel by a surrounding four-foot thick concrete barrier that weighed 800 tons. An additional 600 tons of lead and poly were provided to shield the crew.

The ship's original propulsion plant was removed to make room for the reactor, supporting systems and a control room. An electrical switchyard was placed on the vessel's bow. The ship's superstructure was enlarged to provide work spaces, offices and labs, and living quarters for a 44-man, nuclear-qualified crew. Atop the cargo hold that contained the reactor vessel, a refueling enclosure and a supporting crane were installed.

Extensive conversion work for the former Liberty ship, which had been mothballed in a Gulf Coast Reserve Fleet, took place in a Mobile, Alabama shipyard. That work was completed in early 1966 and world's first floating nuclear power station, which was reclassified as a non-propelled nuclear barge, was towed to Ft. Belvoir, arriving there in April of 1966.

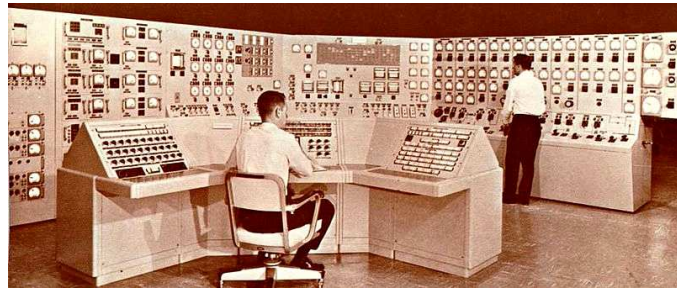




The former Liberty ship was renamed STURGIS, in honor of the late General Sturgis; the Corps of Engineers' leader between 1953 and 1956 and the individual that had spearheaded the creation of the Army's Nuclear Power Program.

In parallel with the ship modification work, a channel from the Potomac River to Ft. Belvoir's Gunston Cove was dredged and a pier built to accommodate the STURGIS. A transmission line from the pier to the local utility grid was also constructed.

In addition, this elaborate analog simulator was installed in the nearby SM-1 reactor building complex for training the STURGIS' nuclear operators. Once the STURGIS was moored at Ft. Belvoir, low enriched uranium fuel was installed.



That event was followed by a series of pre-criticality testing that lasted about five months. The MH-1A reactor first went critical on January 24, 1967, and began supplying electricity to the army base shortly thereafter. The STURGIS remained docked there for several more months while the Corps decided where she might be deployed. One consideration was Viet Nam, but that idea was quickly vetoed by the State Department.

## Panama Canal Zone

Instead, in the spring of 1968, she was towed to the Canal Zone and situated in Gatun Lake. By August of that year, STURGIS was augmenting the local hydroelectric generating system, which could not keep up with demand during the dry season in Panama and at times had to shut down. Otherwise, the lake level would have been too low to permit passage of large vessels using the canal.



After operating in the Canal Zone for a year, the STURGIS' reactor had to be refueled. This operation was conducted in the amazingly short period of time of one week in October of 1969. During the next seven years, STURGIS was refueled four more times.

By early 1976, the Corps was ready to get out of the nuclear power electric generation business. New regulations imposed on nuclear plants for safety, which would have required costly changes to STURGIS. Plus, the Panama Canal Company had purchased additional generating capacity of their own in the form of two 21-MW gas turbines.

There was no other site suitable for the STURGIS, even if her reactor plant had been upgraded. So, in December of 1976, she began the long trip back to Ft. Belvoir for defueling. By January of the next year, she was off the East Coast, under tow and unable to avoid a winter storm of hurricane strength bearing down on her.

## **Storm Damage**

The STURGIS suffered enough storm-related damage that she had to be diverted to a military installation near Wilmington, North Carolina for temporary structural repairs. How close she came to actually sinking is not known, but the men that were onboard during that trying time felt that it was a distinct possibility and were prepared to launch the barge's two lifeboats, if necessary.

Although that did not prove to be necessary, when the STURGIS was safely in port, it was discovered that one of the heavy steel vertical structural members in the refueling area had become permanently bowed. Presumably that damage was caused by the weight of tons of sea water crashing down on the refueling enclosure at the height of the storm.

During that entire episode, the reactor was safely shut down, and the barge's electrical needs were supplied by an auxiliary diesel generator. Nevertheless, Corps officials were relieved that their floating power station didn't sink or be driven ashore by the storm.

## **Deactivated and Mothballed**

The tow from Panama back to Ft. Belvoir ended in March of 1977. Shortly thereafter, the STURGIS' nuclear fuel was removed and her nuclear piping systems and components were decontaminated. Then, it was time for her to endure another tow, albeit a shorter trip this time. The STURGIS was moved to the James River Reserve Fleet. There she was isolated from conventionally powered vessels, but was moored alongside the much larger nuclear-powered passenger-cargo vessel SAVANNAH until that more famous vessel was relocated.



## Ultimate Disposition

It was originally estimated, in 1980, that it might be fifty years before the residual radioactivity contained in the reactor vessel and other tanks onboard STURGIS would decay enough to removal. To ensure that her hull was in good enough shape to remain waterborne for such a long period of time, the STURGIS was dry docked in Norfolk, Virginia, in 1999 for hull inspection, minor repairs, and a through cleaning and painting.



Topside, her superstructure was also painted, giving the illusion of being ready for some useful purpose. After being towed back to the James River Reserve Fleet, she was isolated from the other ships still in the idle fleet. For the next fifteen years, she remained anchored in the James River; a curiosity to many watermen, unaware of her past history.

By late 2013, lower than previously anticipated radioactive readings and an expansive environmental impact study led to a consensus that STURGIS could be safely scrapped. By that time she was one of only nineteen surplus vessels left anchored in the James River. In March of 2014, the Corps of Engineers awarded a contract to a nuclear-capable Texas firm to dismantle and dispose of the MH-1A reactor and other radioactive materials remaining onboard STURGIS.

The plan is to tow her to Galveston, Texas, in September 2014. Although detail plans have not been publicized, it is presumed that her reactor vessel, like those of numerous decommissioned US Navy nuclear-powered ships, will be used to contain other parts of her reactor plant that cannot be easily decontaminated. To create an impenetrable mass and to provide shielding, the reactor vessel presumably will be filled with concrete and perhaps also encapsulated before being shipped to a burial site.

After STURGIS' long-stilled mechanical heart has been removed, what remains will be towed to Brownsville, Texas, where a commercial firm dedicated to scrapping ships will reduce her hull to scrap. That entire process is expected to take four years.



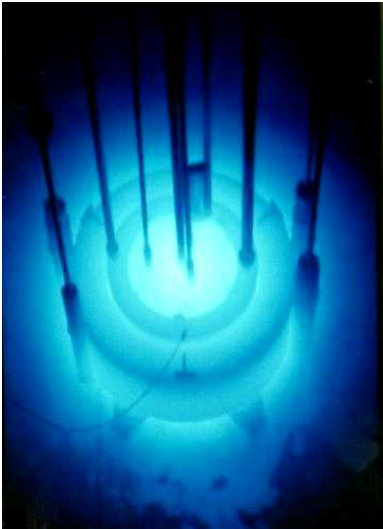
## Postscript

It was at an industry conference in Washington, DC, sometime in the early 1980's, that I became aware that the STURGIS existed. By happenstance, I met an interesting character there; Charlie Brown, a former Army non-commissioned officer nick-named, inevitably, I suppose, '*Good Old Charlie Brown*'. He was a seemingly happy-go-lucky guy who told tall tales over dinner about operating the floating nuclear power station in Panama.

I later learned that he had also served as an instructor at the SM-1 training facility in nearby Ft. Belvoir. Seeking more information, I went there and met one of his former pupils, who showed me this cutaway model of the STURGIS that had once served as a training aid. The model was languishing in a storeroom, almost forgotten; much like STURGIS herself.



The fella who arranged for me to see and photograph the model verified that *Good Old Charlie Brown* was one of the 'best in the business'. A few years later, I saw that for myself during a visit to the Sandia Labs in New Mexico. There, I observed Charlie on the job as their chief nuclear safety officer and witnessed the start-up of a 'swimming pool' reactor used for experimental work. That was the first and only time I ever saw the unearthly bright blue glow known to all 'nucs' as the Cherenkov Effect.



On that occasion, Charlie was, indeed, all business. As a former nuclear test engineer, I recognized and appreciated his competency and correctness when and where it counted. It was apparent that he was cut from the same cloth, albeit khaki, not navy blue, as many non-commissioned naval reactor operators I had once known and admired.

Like Charlie Brown, they often countered the intensity and stress of operating reactor plants with an irrepressible sense of humor and some pretty funny off-duty...well, *mostly* off-duty...antics.

But that's another story...

*Bill Lee*

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