Powering Up: Bringing Modern Electricity Capacity to the NNSS

The original wooden towers of the 138-kV transmission line stand as silent sentinels across the Cold War landscape that once was the site of atmospheric and underground nuclear tests (Photo: DSC_0026, DRI November 2020).

Located in a remote, secure area roughly 60 miles northwest of the heart of Las Vegas, the Nevada National Security Site (NNSS) is one of the nation's premier scientific sites. Since the 1950s the NNSS has provided a number of services in support of its national security mission. It houses accelerators, hosts counterterrorism training, certifies the readiness and safety of the nation's nuclear stockpile, and much more. All of these critical national security activities require a considerable amount of electricity. Supplying power to such faraway areas and critical loads presents unique challenges at the NNSS, which has become increasingly apparent as the nation undergoes modernization efforts to add sustainability and resiliency to traditional utility infrastructure.

The NNSS' historic dependence upon diesel generators as a primary power source was largely overcome in the 1960s by expanding and directing utility electrical power from public generation to government load. Today's government-owned and contractor-operated power system has 138-kiloVolt (kV) transmission spanning more than 100 miles, providing power to the NNSS in a redundant loop that begins and ends at either the Mercury Switching Center or Jackass Flats Substation. Six active 138 kV substations on the loop stepdown transmission supply to distribution voltages.

This distribution power gets routed over another 300-plus mile network to each facility location. Three of the six substations within the mission corridor have redundant capability to supply 34.5 kV distribution power at 2020 baseline demand and consumption needs. Publicly generated power remains entirely backed up by diesel generators specific to their own facilities.

Power infrastructure is designed, constructed and maintained to specifications anticipating multidecade lifespans. Forecasted national security needs for electrical demand and consumption at the NNSS show high growth projections that are likely to require additional capacity in several areas. In addition to adding capacity to and reducing the age of infrastructure, NNSS is planning how and where power generation comes and incorporating new sustainability and resiliency requirements, including net-zero goals. New solutions are already underway to meet these unique challenges.

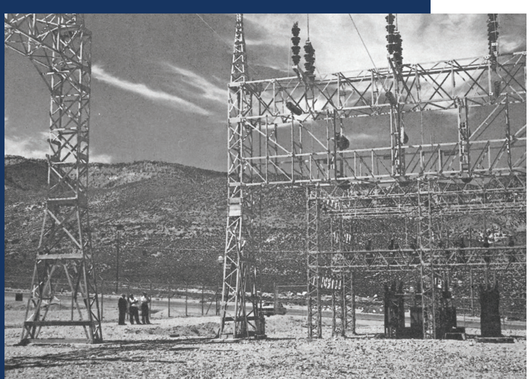
One early success was NNSS' new Fire Station No. 1, powered by photovoltaic (PV) arrays. Fire Station No. 1 was the first net-zero energy building within the National Nuclear Security Administration (NNSA) enterprise. Taking into account its success and the considerable amount of land and sunlight at the NNSS, future infrastructure plans call to scale up PV generation and add multi-hour firming storage to the grid to help meet resiliency needs. Accelerating expansion of PV and storage throughout the 2020s will lead to many more decades of safe, secure and adaptive power for the NNSA enterprise.

The Electric History of the NNSS

Crew working on one of the lower-energy distribution lines in Frenchman Flat. Most of the distribution lines used single pole structures while the 138 kV line was supported by wooden H-frame structures with cross bracing. (REECO neg. 3217-9 August 1970).

When the Nevada Test Site—now known as the Nevada National Security Site—was selected to serve as the United States' continental nuclear testing location in December 1950, it had no support facilities, no infrastructure other than a few rough dirt roads, and no power. The location was far from the power grid at an hour's drive from Las Vegas, a small city of 35,000 residents. Operations began with portable diesel generators, their buried power lines supplying electricity to all the communication systems and instruments monitoring the initial air drop tests. The solution worked, but the Site needed a reliable and plentiful source of power.

To permanently and reliably supply power to a remote, 1,350-square-mile plot of land, plans would need to address not only design and construction efforts, but the maintenance required to keep the equipment functioning long into the future. When staff moved into the buildings in the newly-established base camp Mercury, power was supplied by a local power plant with three diesel-fueled generators that fed a pole-mounted electrical distribution system.



REECo personnel are dwarfed by the 138 kV substation in Area 19. Most of the substations incorporated specialized features to minimize the effects of shock and earth movement that occurred during underground nuclear test detonations. (REECO neg. 1946-9 August 1964).

Energy demands increased as the pace and scale of the testing program ramped up. The Site transitioned to commercial power in 1956, when the Southern Nevada Power Company constructed 64 miles of 69-kilovolt (kV) transmission line from northwest Las Vegas to Mercury. While Mercury now had power to spare, the forward testing areas remained tied to local generators and buried utility lines. The blast effects of atmospheric testing made an overhead electrical system impractical.

That changed when the 1963 Limited Test Ban Treaty permanently moved nuclear tests underground. Commercial power could now be delivered to the forward areas over an above-ground transmission system. The Nevada Power Company upgraded its existing service into Mercury from 69-kV to 138-kV to support the growing power demands, while the Amargosa Valley Electrical Co-op provided stand-by power and redundancy via its newly completed 138-kV transmission line to the Site's western boundary.

Site engineers assumed responsibility for the design of the 138-kV line inside the Site to ensure the transmission system met the special power requirements of the multitude of scientific and technical programs, while anticipating ways to accommodate future load increases and larger transformer capacity.

With the aid of Interstate Electric Company, Site employees built much of the first 50 miles of the 138-kV transmission line and its five original substations. The 138-kV transmission line would quickly become the backbone of the Site's infrastructure, and a myriad of distribution lines rapidly spread across the landscape. Most of the construction was completed by the end of 1964.

By the mid-1990s the power network more than doubled in size, and its poles were dual-purposed to carry the Site's communication network cabling. New substations were added along with hundreds of miles of electrical line and grounding wire. The system eventually included several thousand wooden poles, as well as thousands of ceramic insulators, relays, transformers, circuit breakers, conductors, lightning and surge arrestors, and all the other facets of a vast electrical network.

NNSA℠
National Nuclear Security Administration

For more information, go to:

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