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INFRASTRUCTURE UPGRADES AND REPAIRS FOR IMPROVED MONITORING OF CRUSTAL DEFORMATION AT PIÑON FLAT AND DURMID HILL

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Abstract

This grant provided support for infrastructure upgrades and repairs at two facilities that measure strain changes in Southern California: Piñon Flat Observatory (PFO), between the San Jacinto and San Andreas faults, and at Durmid Hill (DHL), near the southern end of the San Andreas fault. The USGS-sponsored instruments at these locations are a single longbase strainmeter at DHL, and three strainmeters and one tiltmeter at PFO. This grant supported repair of operational infrastructure, including backup power, building repair, electronics upgrades, erosion control and mitigation, improved water systems, new field-lab space, security systems, and site cleanup,

Report

1. Introduction

This grant supported repairs and improvements at two locations in Southern California which are funded by the NEHRP External Program to produce high-quality strain and tilt data: Piñon Flat Observatory (PFO), between the central San Jacinto fault and the Coachella Valley segment of the San Andreas fault, and Durmid Hill (DHL), at the southern end of this San Andreas segment. **Figure 1** shows the locations, with other measuring systems and past large earthquakes; **Figure 2** and **Figure 3** are detailed site plans. Over time, a number of deferred maintenance issues had developed at both sites leading to higher operational costs and decreased data-quality, leading to the need for an investment in infrastructure which this grant supported.

In the next two sections we describe the specific tasks we performed for improving the operations, and data, at PFO and DHL. These efforts all fit within the ARRA specification of ‘‘invest in infrastructure that will provide long-term economic benefits’’ since these now allow us to operate these facilities at lower cost than if these investments were not made. They also ‘‘preserve and create jobs and promote economic recovery’’, since they mostly involve construction tasks; indeed, much of the work in the field was done by Mr. Mike Lawliss, a builder and contractor living in the Pinyon Flat area, who was available because of the downturn in construction over the last few years. His location meant that we could greatly reduce the travel costs for this effort.

2. Work at PFO

For each task performed, we first summarize its relevance to the operation, and then describe what was done.

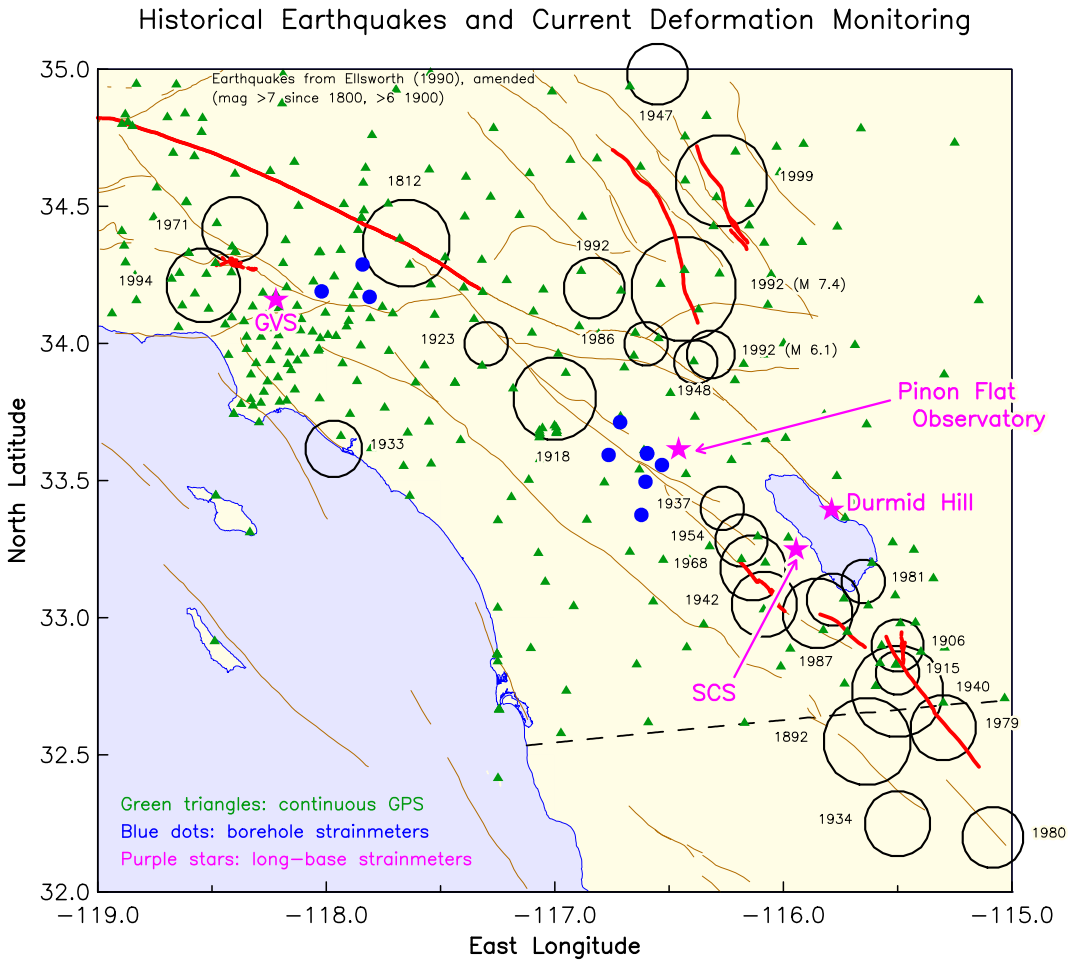

Figure 1

- **Backup Electric Power:**

The quality of the data from the instrument at PFO is seriously degraded by interruptions in power; these are relatively frequent because we are the edge of the distribution network for the local utility: Anza Electric, a rural electricity cooperative. Longer power outages were dealt with by a 30 kW standby generator, given to us by the UC Medical Center in the 1970's; but this failed in early 2009 and could not be repaired. We used funds from this grant to purchase and install a replacement backup generator (Onan/Cummins RS30000) for $11,843; this is compatible with our existing Automatic Transfer Switch, which makes the critical decisions on the start-up and switch-over to standby power. This has been installed and is operating.

- **Site Security:**

PFO is a large facility, not fenced off from local access, and with many buildings housing expensive systems: two large trailers which serve as our main indoor working area, the North and West ends of the NS and EW laser strainmeters, three vaults used for seismic instruments three vaults for the long fluid tiltmeter, two vaults for the NWSE strainmeter, two end-buildings for the NS and EW strainmeter, and about a dozen smaller enclosures, housing such things as GPS equipment.

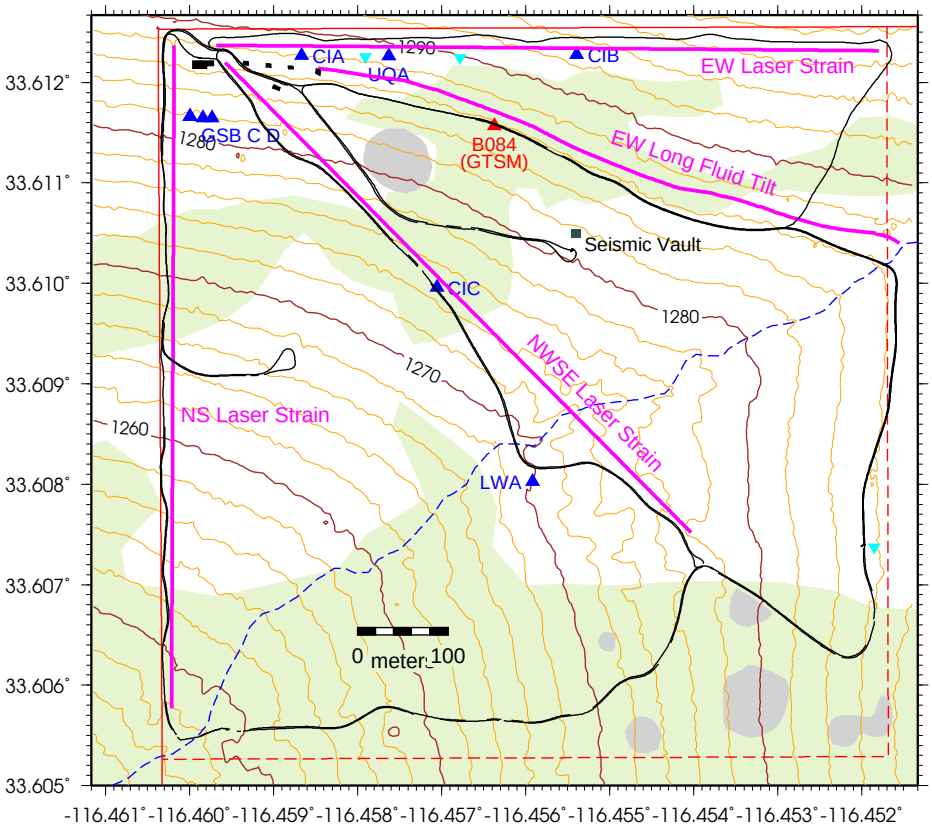

Figure 2

We have had some vandalism, and attempted break-ins to the larger structures; we had installed security systems over the years in a piecemeal fashion. This grant allowed us to purchase and install a modern security system that has the option of sending an automatic notification to a security center (systems that provide such notification directly to the user are no longer available).

- **Fire Safety: Access:** As in most rural areas of California, fire is a significant risk at PFO (indeed we experienced just this in 1994, with extensive damage); the local vegetation is brush and scattered trees. While we clear brush around buildings, this is not practicable for the strainmeter vacuum pipes. To provide better access for fire crews, we repaired the extensive system of unpaved roads at the site, removing obstructing trees and brush, and regrading to remove gullies created by intense summer rains.
- **Fire Safety: Water:** Our water system is a 5200 gallon tank, fed from a well. We repaired some aging parts of the system, and installed a quick-connect valve to the tank, as mandated by the California Division of Forestry, to make the water readily available in case of future fires.
- **Strainmeter End-Buildings and Other Structures:** To keep initial costs low, many of the buildings are wooden; these do however require more maintenance. For example, several of the strainmeter end buildings developed holes that allowed both rain and rodents inside, the latter particularly disruptive to the measurement systems. These were repaired. About 20 other

outbuildings and small instrument shelters had, over time, reached various states of disrepair, in some cases to the point of near-collapse. These were rebuilt with new materials where necessary, and repaired.

- **Utility Room:** At the west end of the main trailer is a utility room that serves as the shop area and shelter for tools and supplies. This attached structure was installed 40 years ago on an elevated pylon-and-post foundation that had gradually failed. Several temporary measures were taken over the past several years to try to stabilize the room. With this funding, the entire building was raised (nearly a foot), restored laterally to its correct position, and a seismically resistant footing was constructed underneath it.

- **Site Cleanup:** Over time disused components, damaged cabling, and considerable construction debris had accumulated (not all of this ours, see below); these had been gathered into one area, but this then created an attractive nuisance, with local residents sometimes regarding it as their disposal area. Some 12 tons of materials not otherwise reusable was gathered and hauled away. Broken-up (clean) concrete was collected from across the site and made available as fill for erosion control.

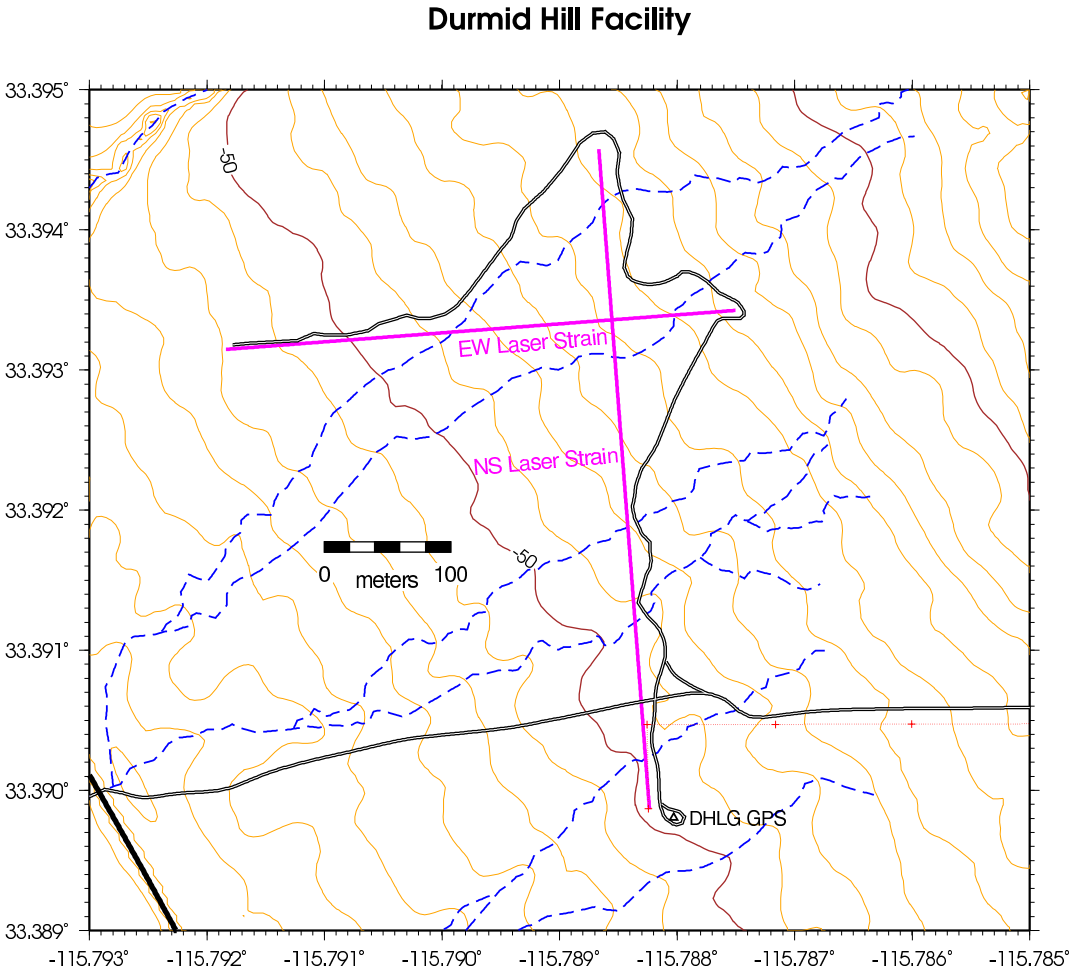

Figure 3

• **Additional Lab Space:** To provide additional space at PFO (something requested by a number of researchers) we moved two shipping containers, fully outfitted with power, insulation, and air conditioning (a $15K value) to PFO from DHL, where they had been used earlier as end-buildings for an NSF-sponsored project. A large part of this effort involved completing the support pad for these structures.

3. Work at DHL

• **Strainmeter Bridges:** At Durmid Hill the NS strainmeter is completely buried; but where it crossed local washes (the larger ones are shown in **Figure 3** as dashed lines) we initially built special supports to bridge these with protective covers over the pipe. For access roads we used culverts covered with fill. Over time these fast-evolving flood-washes eroded further, exposing the strainmeter pipes and making the road culverts unsafe. At a number of the washes we restored the ravine walls with non-erodible material (sandbagged sand with some concrete), and repaired the culverts.

• **Electronics Upgrades:** The NS strainmeter at Durmid Hill was installed in 1994, and over time became the least updated of any of the longbase strainmeters. By constructing additional electronics boards, and installing existing ones into appropriate packages, we have been able to make the electronics the same as at our other nine systems. This improves performance and makes repairs much less costly because problems in the field can be diagnosed and treated by swapping in a spare (standardized systems), and troubleshoot the problem in the lab.

Bibliography of Publications

None