

**Outside Witness Testimony (OWT) of David Jonas Bardin** prepared for  
**Interior, EPA, and Related Agencies Subcommittee** of Senate Committee on Appropriations re  
**Department of the Interior — USGS — Geomagnetism Program — Fiscal Year 2021 Appropriations**  
March 11, 2020

Chairman Murkowski and Ranking Member Udall,

**I support the requested \$4.1 million for FY 2021, with enhancements**, because the USGS Geomagnetism Program is essential to protect USA's 16 critical infrastructures, which depend on the grid.

I am a Secure the Grid (STG) Coalition [1] volunteer; I express my individual views. They reflect my public and private sector professional experiences as an advisor, regulator, executive, and advocate. After active U.S. Army duty, 1956-58, I focused on energy, environment, and public utility issues, including service at the Federal Power Commission (now FERC), 1958-69, N. J. Department of Environmental Protection, 1974-77, and Federal Energy Administration / U.S. Department of Energy, 1977-79. I am a retired member of Arent Fox, LLP. I submit this testimony *pro bono*. No one pays me to do this.

*My Written Testimony supports the Administration's USGS Geomagnetism Program Request for FY 2021 (made Feb. 10, 2020) — with Congressional enhancements, directions, and clarification inquiries.*

- That Request is for \$4.1M for FY 2021 (compared with \$4.0M as enacted for FY 2020). See Department of the Interior (DoI) FY 2021 Budget Justification for USGS ("Greenbook") [2] at <https://www.doi.gov/sites/doi.gov/files/uploads/fy2021-usgs-budget-justification.pdf> (especially pp. 60-62). Also see my historic **Table** at page 4, below, showing flat appropriations, sequester impact, and flat appropriations again, until December's Minibus.
- STG Coalition members lobbied Senate Appropriators for the USGS Geomagnetism funding in Pub. Law No. 116-94, approved Dec. 20, 2019. [3]

*STG Coalition; InfraGard National Disaster Resilience Council; and Electric Infrastructure Security Council.* STG Coalition, InfraGard National Disaster Resilience Council (formerly EMP SIG), and the Electric Infrastructure Security Council (EISC) have helped shape my concern about "Black Sky" hazards — catastrophic events that severely disrupt normal functioning of our critical infrastructures for multiple regions for long duration. [4] So, too, the President's National Infrastructure Advisory Council. [5] A robust USGS Geomagnetism Program is a necessary element for protecting the electric power grid against such an event. For example, USGS geomagnetism research and data are required to improve forecast models that NOAA's Space Weather Prediction Center uses to inform electrical system operators of impending solar storms so that they may minimize impacts of a storm when it does hit the Earth.

*The USGS Greenbook's Program Overview* (at p. 61) broadly explains this vital Program:

"Magnetic storms are caused by the dynamic interaction of the Earth's magnetic field with the Sun. [They can] wreak havoc on the infrastructure and activities of our modern, technologically based society. Large storms can induce voltage surges in electric-power grids, causing blackouts and the loss of radio communication, reduce GPS accuracy, damage satellite electronics, and affect satellite operations, enhance radiation levels for astronauts and high-altitude pilots, and interfere with directional drilling for oil and gas.

"In order to understand and mitigate geomagnetic hazards, the USGS Geomagnetism Program monitors and analyzes the Earth's dynamic magnetic field. The Program is part of the U.S. National Space Weather Program (NSWP), an interagency collaboration that includes programs in the National Aeronautics and Space Administration (NASA), DOD, NOAA, and NSF. The Geomagnetism Program provides data to the NSWP agencies, oil drilling services companies,

geophysical surveying companies, and several international agencies. Data, products, and services from the USGS are also used by the electric-power industry to evaluate geomagnetic storm risk.

“Domestically, the USGS works cooperatively with NOAA, the Air Force 557th Weather Wing, and other Federal agencies. For example, USGS observatory data are used by NOAA’s Space Weather Prediction Center, and by the U.S. Air Force, for issuing geomagnetic warnings and

Page 2 of 4

forecasts. The USGS magnetic observatory network is part of the global INTERMAGNET network. The USGS research is conducted in collaboration with the Colorado School of Mines, the USGS Crustal Geophysics and Geochemistry Science Center, the NOAA Space Weather Prediction Center and the NASA Community Coordinated Modeling Center.

“The USGS also works with private entities that are affected by space weather and geomagnetic activity, including electric-power grid companies ... .”

*Summary of position; conclusions and recommendations.* Congress should approve FY 2021 Request with following *directions, clarifications and enhancements* — reaching out to USGS for information:

### **MT Survey(s) Implementation Plan(s)**

Like other NSWP agencies, USGS’s Geomagnetism Program supported completion of the reconnaissance magnetotelluric survey (MT survey) of the contiguous United States (CONUS); but it didn’t have budget responsibilities prior to FY 2020. Almost all of the MT survey to date was funded through the National Science Foundation (NSF) and implemented by Oregon State University (OSU). [6] On Feb. 20, 2020, USGS and OSU and others publicly presented valuable updates at a meeting in Salt Lake City.[7]

**USGS has not yet issued any MT Survey *implementation plans*** for FY 2020, or 2021, or later years.

— For FY 2020, the Request and the December 2019 enactment specified \$1.726M for MT survey.

— But the FY 2021 Request does not specify any MT survey amount.

— And **of the \$1.726M** specified for FY 2020, **none has yet been obligated.** (At Salt Lake City, OSU reported that “proposal submitted to execute MT Array data acquisition program” was “pending review”.)

— USGS now advises that it continues to move forward with executing the **FY20** funding and is making steady progress with the necessary approvals. But it’s a procurement-sensitive internal process, so there’s not much they can convey to me ahead of a public announcement, which they promise to surely make.

— If that happens before your March 20 deadline, I may submit supplemental OWT.

**A) As to FY21, please ask USGS, within 90 days,** (a) to suggest specified expenditure levels in FY 2021 (and subsequent years) “to continue” the MT survey (see endnote [6]) and (b) to provide realistic data as to field campaign seasons, number of field stations, and likely campaign costs.

**B) Please direct that a *specified FY 2021 amount*** be spent exclusively on MT survey — having your staffs discuss with USGS whether \$1.726M (same as enacted for FY 2020) would be a reasonable specific amount

— We learned in Salt Lake City that remaining NASA funding for MT survey may not cover as much of CA, NV, and AZ as USGS hopes / anticipates because reconnaissance MT survey may need more funding (and an extension of data collection into 2023) to install or redo some California sites due to permitting delays for sites on BLM land and for quality reasons and because each MT site may require extra weeks of field work during the solar cycle’s current low-activity period.

— In addition, we learned that USGS expects a need to follow up the reconnaissance survey with a denser survey in some areas due to high geo-hazard and/or extremely critical infrastructure, for national security reasons. That deserves strong support.

**C) Please also direct USGS to analyze and report to Appropriators within 60 days** (a) likely future needs for denser, follow-up MT surveying (added to reconnaissance MT survey) in high geo-hazard areas near especially critical infrastructure, for national security reasons, with estimated costs and timetables and (b) a likely, realistic timetable for completing field work for a quality reconnaissance MT survey. [8]

### Observatories and variometer stations [9]

**D) Please determine whether** Administration's two proposed increases above FY 2020 enacted \$4.0M — \$25,000 for Fixed Costs [10] and \$114,000 for Observatory Operations — would suffice to operate 14 permanent, ground-based observatories *and* to address their deferred maintenance backlogs. [11]

**E) Please direct USGS to report to Appropriators within 60 days:** (a) identifying gaps in its network of observatories, and (b) indicating options, timetables, estimated costs and priorities for closing such gaps by means of new observatories and/or variometer stations. [12]

Page 3 of 4

**F) In the meantime, please (a) direct USGS to install** at least two new observatories or permanent variometer stations during FY 2021 and FY2022 (a two-year effort) **and (b) enhance the Request** commensurately (based on installation and operating cost estimates your staff acquires from USGS).

**G) Please compliment USGS** for its cost-effective leveraging of equipment at seismic and geomagnetic station sites in order to help achieve missions of both programs.

Respectfully submitted, *David Jonas Bardin* [[davidbardin@aol.com](mailto:davidbardin@aol.com)]

#### Endnotes:

[1] See <https://securethegrid.com>.

[2] The Request proposes no cuts to the Geomagnetism Program, yet Greenbook p. 62, line 2, mistakenly parrots boilerplate which applies only to cuts in *other* Programs ["The budget does not request funding for these activities in order to address other priorities"]. For USGS as a whole, Administration proposes a cut of \$300M. See <https://www.doi.gov/sites/doi.gov/files/uploads/fy2021-bib-bh053.pdf>.

[3] H.R. 1865 - Further Consolidated Appropriations Act, 2020 (116th Cong.) — 2019 Minibus.

[4] See <https://www.empcenter.org> and <https://www.eiscouncil.org/BlackSky.aspx>.

[5] See NIAC, [Surviving a Catastrophic Power Outage](#) (2018).

[6] NASA provided funds for OSU work in FY 2019 and 2020, at a reduced pace. Previously, a USGS component MT-surveyed peninsular Florida and a few smaller areas.

The USGS Greenbook vaguely states (at p. 62): "In 2021, USGS will continue the magnetotelluric (MT) survey of the U.S. to improve U.S. electrical grid resilience, improve forecast models for geomagnetic storms, and aid in mineral resource assessments. Collection of MT data on a national scale is a basis for modeling the Earth's electric field, which can be used to assess the impact of electrical storms. This survey is responsive to priorities established in the *National Space Weather Strategy*, as well as related international initiatives for pursuing induction hazard research. This broad collaboration includes scientists from NASA, NOAA, the Institute for Defense Analyses, the Federal Energy Regulatory Commission, the Federal Emergency Management Agency, and NSF."

[7] See

[https://www.nerc.com/comm/PC/Geomagnetic%20Disturbance%20Task%20Force%20GMDTF%202013/Agenda\\_gmdtf\\_package\\_feb\\_20.pdf](https://www.nerc.com/comm/PC/Geomagnetic%20Disturbance%20Task%20Force%20GMDTF%202013/Agenda_gmdtf_package_feb_20.pdf) (totaling 314 PDF pages). USGS: PDF pages 64-71; 301-305; OSU: 72-108.

[8] President's EMP Executive Order of March 26, 2019 (EO 13865) gave the Secretary of the Interior four years to complete that MT Survey. Request interprets EO as calling for a "three-year effort" (Greenbook at pp. 2 and 60), ending in March or April 2023, in middle of FY 2023, of which FY 2021 is "second" year. But MT Survey field work gets done mainly during warmer months of calendar year (each campaign season beginning in March or April).

[9] USGS describes its 14 geomagnetic observatories at [https://www.usgs.gov/natural-hazards/geomagnetism/science/observatories?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/natural-hazards/geomagnetism/science/observatories?qt-science_center_objects=0#qt-science_center_objects).

— Ground-based monitoring of geomagnetic field variation (for frequencies less than 1 Hz) is typically accomplished with a fluxgate magnetometer or "variometer." For many applications, raw variometer data are sufficient, but for other applications, "observatory"-standard data are required, whereby the drifting variometer response is minimized through temperature stabilization and, otherwise, corrected in data processing with application of auxiliary calibration measurements. Magnetic observatories are more expensive and labor-intensive to operate than variometer stations, and their geographic distribution is relatively sparse; variometer stations are less expensive to operate and their deployments are sometimes geographically dense.

— USGS magnetic observatories are operated with a 99%+ temporal continuity, for decades of time, and data from each observatory are promptly made openly available to the user community in near-real-time.

— Variometer stations in the United States are typically operated on a campaign basis by universities for specific research projects, often funded by the National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA). These variometer operations are not usually intended to provide long-term, continuous, real-time data service; for this reason, variometer data are not commonly used in operational space-weather projects, such as those supported by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Air Force (USAF).

[10] Determined for every USGS Program per OMB formula. See USGS Greenbook table at p. 116.

[11] The Greenbook merely states (at p. 62): “In 2021, the USGS will continue to operate 14 geomagnetic observatories, delivering data to the NOAA Space Weather Prediction Center, the US Air Force 557th Weather Wing, and numerous other customers, and will develop geoelectric hazard maps, develop existing data sets needed to estimate Earth surface impedance, and develop computer-based tools need for real-time mapping of geomagnetic and geoelectric field variation.”

[12] See PDF page 65 of 314 in Salt Lake City meeting sources cited in endnote [7], above.

Table:

**USGS GEOMAGNETISM PROGRAM BUDGETS UNDER NATURAL HAZARDS MISSION,  
2008-2020, COMPARED WITH 2021 REQUEST PROPOSALS**

(See <https://www.usgs.gov/about/organization/science-support/budget/usgs-budget-archives>)

Dollars to closest 1/10th of a million (\$x.yM)

Fiscal Year	Request (\$ mil)	Enacted	References: "Greenbook", Public Law No.
2008	\$2.1	\$2.1M	<a href="https://edit.doi.gov/sites/doi.gov/files/migrated/budget/appropriations/2008/upload/FY2008_USGS_Greenbook.pdf">https://edit.doi.gov/sites/doi.gov/files/migrated/budget/appropriations/2008/upload/FY2008_USGS_Greenbook.pdf</a> ; Public Law No. 110-161
2009	\$2.1	\$2.1M	<a href="https://edit.doi.gov/sites/doi.opengov.ibmcloud.com/files/uploads/FY2009_USGS_Greenbook.pdf">https://edit.doi.gov/sites/doi.opengov.ibmcloud.com/files/uploads/FY2009_USGS_Greenbook.pdf</a> ; Pub. L. 111-8
2010	\$2.1	\$2.1M	<a href="https://edit.doi.gov/sites/doi.opengov.ibmcloud.com/files/uploads/FY2010_USGS_Greenbook.pdf">https://edit.doi.gov/sites/doi.opengov.ibmcloud.com/files/uploads/FY2010_USGS_Greenbook.pdf</a> ; Pub. L. 111-117
2011	\$2.1	\$2.1M	<a href="https://edit.doi.gov/sites/doi.opengov.ibmcloud.com/files/uploads/FY2011_USGS_Greenbook_part1.pdf">https://edit.doi.gov/sites/doi.opengov.ibmcloud.com/files/uploads/FY2011_USGS_Greenbook_part1.pdf</a> ; Pub. L. 112-10
2012	\$2.1	\$2.1M	<a href="https://edit.doi.gov/sites/doi.opengov.ibmcloud.com/files/uploads/FY2012_USGS_Greenbook.pdf">https://edit.doi.gov/sites/doi.opengov.ibmcloud.com/files/uploads/FY2012_USGS_Greenbook.pdf</a> ; Pub. L. 112-74
2013	\$2.2	\$2.0M	<a href="https://edit.doi.gov/sites/doi.gov/files/migrated/budget/appropriations/2013/upload/FY2013_USGS_Greenbook.pdf">https://edit.doi.gov/sites/doi.gov/files/migrated/budget/appropriations/2013/upload/FY2013_USGS_Greenbook.pdf</a> ; Pub. L. 113-6
2014	\$2.1	\$1.9M	<a href="https://www.doi.gov/sites/doi.gov/files/migrated/budget/appropriations/2014/upload/FY2014_USGS_Greenbook.pdf">https://www.doi.gov/sites/doi.gov/files/migrated/budget/appropriations/2014/upload/FY2014_USGS_Greenbook.pdf</a> ; Pub. L. 113-76
2015	\$1.9	\$1.9M	<a href="https://www.doi.gov/sites/doi.gov/files/migrated/budget/appropriations/2015/upload/FY2015_USGS_Greenbook.pdf">https://www.doi.gov/sites/doi.gov/files/migrated/budget/appropriations/2015/upload/FY2015_USGS_Greenbook.pdf</a> ; Pub. L. 113-235
2016	\$3.6	\$1.9M	<a href="https://www.doi.gov/sites/doi.gov/files/migrated/budget/appropriations/2016/upload/FY2016_USGS_Greenbook.pdf">https://www.doi.gov/sites/doi.gov/files/migrated/budget/appropriations/2016/upload/FY2016_USGS_Greenbook.pdf</a> ; Pub. L. 114-113
2017	\$3.6	\$1.9M	<a href="https://edit.doi.gov/sites/doi.gov/files/uploads/FY2017_USGS_Budget_Justification.pdf">https://edit.doi.gov/sites/doi.gov/files/uploads/FY2017_USGS_Budget_Justification.pdf</a> ; Pub. L. 115-30
2018	\$0.0	\$1.9M	<a href="https://edit.doi.gov/sites/doi.gov/files/uploads/fy2018_usgs_budget_justification.pdf">https://edit.doi.gov/sites/doi.gov/files/uploads/fy2018_usgs_budget_justification.pdf</a> ; Pub. L. 115-124
2019	\$0.0	\$1.9M	<a href="https://edit.doi.gov/sites/doi.gov/files/uploads/fy2019_usgs_budget_justification.pdf">https://edit.doi.gov/sites/doi.gov/files/uploads/fy2019_usgs_budget_justification.pdf</a> ; Pub. L. 116-6
2020	\$1.9 *	\$4.0M	<a href="https://edit.doi.gov/sites/doi.gov/files/uploads/fy2020_usgs_budget_justification.pdf">https://edit.doi.gov/sites/doi.gov/files/uploads/fy2020_usgs_budget_justification.pdf</a> ; Public Law 116-194
2021	\$4.1 **	?	<a href="https://www.doi.gov/sites/doi.gov/files/uploads/fy2021-usgs-budget-justification.pdf">https://www.doi.gov/sites/doi.gov/files/uploads/fy2021-usgs-budget-justification.pdf</a> .

\* 2020 Minerals Mission Request included \$1,726,000 (\$1.7M) for MT Survey which Pub. L. 116-194 instead funded under Natural Hazards Mission in Geomagnetism Program as a specified part of \$4,000,000 (\$4.0M) total. FY 2020 was first USGS Budget that mentioned MT Survey.

\*\* 2021 Geomagnetism Request would add \$25,000 for Fixed.Costs to \$4.0M enacted for 2020 and also change same upward by +\$114,000 for Observatory Operations (with no cuts specified; but it does not specify any dollar amount for MT Survey).