AMENDMENT NO._____ Calendar No._____

Purpose: In the nature of a substitute.

IN THE SENATE OF THE UNITED STATES—114th Cong., 2d Sess.

S. 2817

To improve understanding and forecasting of space weather events, and for other purposes.

Referred to the Committee on _____ and ordered to be printed

Ordered to lie on the table and to be printed

AMENDMENT IN THE NATURE OF A SUBSTITUTE intended to be proposed by _____

Viz:

Strike all after the enacting clause and insert the following:

SECTION 1. SHORT TITLE.

This Act may be cited as the "Space Weather Research and Forecasting Act".

SEC. 2. SPACE WEATHER.

(a) IN GENERAL.—Subtitle VI of title 51, United States Code, is amended by adding after chapter 605 the following:

"CHAPTER 607—SPACE WEATHER

"§ 60701. Space weather

"(a) FINDINGS.—Congress makes the following findings:

"(1) Space weather events pose a significant threat to humans working in the space environment and to modern technological systems.

"(2) The effects of severe space weather events on the electric power grid, satellites and satellite communications and information, airline operations, astronauts living and working in space, and space-based position, navigation, and timing systems could have significant societal, economic, national security, and health impacts.

"(3) Earth and space observations provide crucial data necessary to predict and warn about space weather events.

"(4) Clear roles and accountability of Federal departments and agencies are critical for an efficient and effective response to threats posed by space weather.

"(5) In October 2015, the National Science and Technology Council published a National Space Weather Strategy and a National Space Weather Action Plan seeking to integrate national space weather efforts and add new capabilities to meet increasing demand for space weather information.

"(b) FEDERAL AGENCY ROLES.—

"(1) FINDINGS.—Congress finds that—

"(A) the National Oceanic and Atmospheric Administration provides operational space weather forecasting and monitoring for civil applications, maintains ground and space-based assets to provide observations needed for forecasting, prediction, and warnings, and develops requirements for space weather forecasting technologies and science;

"(B) the Department of Defense provides operational space weather forecasting, monitoring, and research for the department's unique missions and applications;

"(C) the National Aeronautics and Space Administration provides increased understanding of the fundamental physics of the Sun-Earth system through space-based observations and modeling, develops new space-based technologies and missions, and monitors space weather for NASA's space missions;

"(D) the National Science Foundation provides increased understanding of the Sun-Earth system through ground-based measurements, technologies, and modeling;

"(E) the Department of the Interior collects, distributes, and archives operational ground-based magnetometer data in the United States and its territories, and works with the international community to improve global geophysical monitoring; and

"(F) the Federal Aviation Administration provides operational requirements for space weather services in support of aviation and for coordination of these requirements with the International Civil Aviation Organization, integrates space weather data and products into the Next Generation Air Transportation System, and conducts real-time monitoring of the charged particle radiation environment to protect the health and safety of crew and passengers during space weather events.

"(2) OFFICE OF SCIENCE AND TECHNOLOGY POLICY.—The Director of the Office of Science and Technology Policy shall—

"(A) coordinate the development and implementation of Federal Government activities to improve the Nation's ability to prepare, avoid, mitigate, respond to, and recover from

potentially devastating impacts of space weather events; and

"(B) coordinate the activities of the National Space Weather Program members.

"(c) SPACE WEATHER INTERAGENCY WORKING GROUP.—In order to continue coordination of executive branch efforts to understand, prepare, coordinate, and plan for space weather, the National Science and Technology Council shall establish an interagency working group on space weather that includes representatives of the Federal agencies participating in the National Space Weather Program, and of other Federal agencies, as appropriate.

"(d) NATIONAL SPACE WEATHER PROGRAM.—In order to understand and respond to the adverse effects of space weather, the National Space Weather Program shall leverage capabilities across participating Federal agencies, including—

"(1) the National Oceanic and Atmospheric Administration;

"(2) the National Aeronautics and Space Administration;

"(3) the National Science Foundation;

"(4) the Department of Defense;

"(5) the Department of the Interior;

"(6) the Department of Homeland Security;

"(7) the Department of Energy;

"(8) the Department of Transportation, including the Federal Aviation Administration; and

"(9) the Department of State.

"(c) INTERAGENCY AGREEMENTS.—

"(1) SENSE OF CONGRESS.—It is the sense of Congress that the interagency collaboration between the National Aeronautics and Space Administration and the National Oceanic and Atmospheric Administration on terrestrial weather observations provides—

"(A) an effective mechanism for improving weather and climate data collection while avoiding unnecessary duplication of capabilities across Federal agencies; and

"(B) an agency collaboration model that could benefit space weather observations.

"(2) INTERAGENCY AGREEMENTS.—The Administrator of the National Aeronautics and Space Administration and the Administrator of the National Oceanic and Atmospheric Administration shall enter into 1 or more interagency agreements providing for cooperation and collaboration in the devel-

opment of space weather spacecraft, instruments, and technologies in accordance with this chapter.

"§ 60702. Observations and forecasting

"(a) POLICY.—It is the policy of the United States to establish and sustain a baseline capability for space weather observations.

"(b) INTEGRATED STRATEGY.—

"(1) IN GENERAL.—The Director of the Office of Science and Technology Policy, in coordination with the Administrator of the National Oceanic and Atmospheric Administration, the Administrator of the National Aeronautics and Space Administration, the Director of the National Science Foundation, and the Secretary of Defense, and in consultation with the academic and commercial communities, shall develop an integrated strategy for solar and solar wind observations beyond the lifetime of current assets, that considers—

"(A) the provision of solar wind measurements and other measurements essential to space weather forecasting; and

"(B) the provision of solar and space weather measurements important for scientific purposes.

"(2) CONSIDERATIONS.—In developing the strategy under paragraph (1), the Director of the Office of Science and Technology Policy shall consider small satellite options, hosted payloads, commercial options, international options, and prize authority.

"(c) CRITICAL OBSERVATIONS.—In order to sustain current space-based observational capabilities, the Administrator of the National Aeronautics and Space Administration shall—

"(1) in cooperation with the European Space Agency, maintain operations of the Solar and Heliospheric Observatory/Large Angle and Spectrometric Coronagraph (referred to in this section as 'SOHO/LASCO') for as long as the satellite continues to deliver quality observations; and

"(2) prioritize the reception of LASCO data.

"(d) ADDITIONAL CAPABILITY FOR SOLAR IMAGING.—

"(1) IN GENERAL.—The Administrator of the National Oceanic and Atmospheric Administration shall secure reliable secondary capability for near real-time coronal mass ejection imagery.

"(2) OPTIONS.—The Administrator of the National Oceanic and Atmospheric Administration, in

coordination with the Secretary of Defense and the Administrator of the National Aeronautics and Space Administration, shall develop options to build and deploy 1 or more instruments for near real-time coronal mass ejection imagery.

"(3) CONSIDERATIONS.—In developing options under paragraph (2), the Administrator of the National Oceanic and Atmospheric Administration shall consider commercial solutions, prize authority, academic and international partnerships, and opportunities to deploy the instrument or instruments as a secondary payload on an upcoming planned launch.

"(4) COSTS.—In implementing paragraph (1), the Administrator of the National Oceanic and Atmospheric Administration shall prioritize a cost-effective solution.

"(5) OPERATIONAL PLANNING.—The Administrator of the National Oceanic and Atmospheric Administration shall develop an operational contingency plan to provide continuous space weather forecasting in the event of a SOHO/LASCO failure.

"(6) BRIEFING.—Not later than 120 days after the date of enactment of the Space Weather Research and Forecasting Act, the Administrator of the National Oceanic and Atmospheric Administra-

tion shall provide a briefing to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives on the options for building and deploying the instrument or instruments described in paragraph (2) and the operational contingency plan developed under paragraph (5).

"(e) FOLLOW-ON SPACE-BASED OBSERVATIONS.—The Administrator of the National Oceanic and Atmospheric Administration, in coordination with the Secretary of Defense, shall develop requirements and a plan for follow-on space-based observations for operational purposes, in accordance with the integrated strategy developed under subsection (b).

"(f) REPORT.—Not later than 180 days after the date of enactment of the Space Weather Research and Forecasting Act, the Director of the Office of Science and Technology Policy shall submit to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives a report on the integrated strategy under subsection (b), including the plans for follow-on space-based observations under subsection (e).

"(g) GROUND-BASED OBSERVATIONS.—The National Science Foundation, the Air Force, and where practicable in support of the Air Force, the Navy shall each—

"(1) maintain ground-based observations of the Sun; and

"(2) provide space weather data by means of its set of ground-based facilities, including radars, lidars, magnetometers, radio receivers, aurora and airglow imagers, spectrometers, interferometers, and solar observatories.

"(h) GROUND-BASED OBSERVATIONS DATA.—The National Science Foundation shall—

"(1) provide key data streams from the platforms described in subsection (g) for research and to support space weather model development;

"(2) develop experimental models for scientific purposes; and

"(3) support the transition of the experimental models to operations where appropriate.

"§ 60703. Research and technology.

"(a) USER NEEDS.—

"(1) IN GENERAL.—The Administrator of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and where practicable in support of the Air Force, the Secretary of

the Navy, in conjunction with the heads of other relevant Federal agencies, shall conduct a comprehensive survey to identify and prioritize the needs of space weather forecast users, including space weather data and space weather forecast data needed to improve services and inform research priorities and technology needs.

"(2) CONTENTS.—In conducting the comprehensive survey under paragraph (1), the Administrator of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and where practicable in support of the Air Force, the Secretary of the Navy, at a minimum, shall—

"(A) consider the goals for forecast lead time, accuracy, coverage, timeliness, data rate, and data quality for space weather observations;

"(B) identify opportunities to address the needs identified under paragraph (1) through collaborations with academia, the private sector, and the international community;

"(C) identify opportunities for new technologies and instrumentation to address the needs identified under paragraph (1); and

"(D) publish a report on the findings under subparagraphs (A) through (C).

"(3) PUBLICATION.—Not later than 1 year after the date of enactment of the Space Weather Research and Forecasting Act, the Administrator of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and where practicable in support of the Air Force, the Secretary of the Navy, shall—

"(A) make the results of the comprehensive survey publicly available; and

"(B) notify the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives of the publication under subparagraph (A).

"(b) RESEARCH ACTIVITIES.—

"(1) BASIC RESEARCH.—As part of the National Space Weather Program, the Director of the National Science Foundation, Administrator of the National Aeronautics and Space Administration, and Secretary of Defense shall continue to carry out basic research activities on heliophysics, geospace science, and space weather and support competitive, merit-based, peer-reviewed proposals for research,

modeling, and monitoring of space weather and its impacts, including science goals outlined in Solar and Space Physics Decadal surveys conducted by the National Academy of Sciences.

"(2) MULTIDISCIPLINARY RESEARCH.—

"(A) FINDINGS.—Congress finds that the multidisciplinary nature of solar and space physics creates funding challenges that require coordination across scientific disciplines and Federal agencies.

"(B) MULTIDISCIPLINARY RESEARCH.—As part of the National Space Weather Program, the Director of the National Science Foundation, the Administrator of the National Oceanic and Atmospheric Administration, and the Administrator of the National Aeronautics and Space Administration shall pursue multidisciplinary research in subjects that further our understanding of solar physics, space physics, and space weather.

"(C) SENSE OF CONGRESS.—It is the sense of Congress that the Administrator of the National Aeronautics and Space Administration and Director of the National Science Founda-

tion should support competitively awarded Heliophysics Science Centers.

"(c) SCIENCE MISSIONS.—The Administrator of the National Aeronautics and Space Administration shall seek to implement missions that meet the science objectives identified in Solar and Space Physics Decadal surveys conducted by the National Academy of Sciences.

"(d) RESEARCH TO OPERATIONS.—

"(1) IN GENERAL.—The Administrator of the National Aeronautics and Space Administration, the Director of the National Science Foundation, the Administrator of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and where practicable in support of the Air Force, the Secretary of the Navy, shall—

"(A) develop a formal mechanism to transition National Aeronautics and Space Administration, National Science Foundation, Air Force, and Navy research findings, models, and capabilities, as appropriate, to National Oceanic and Atmospheric Administration and Department of Defense space weather operational forecasting centers; and

"(B) enhance coordination between research modeling centers and forecasting centers.

"(2) OPERATIONAL NEEDS.—The Administrator of the National Oceanic and Atmospheric Administration and the Secretary of Defense, in coordination with the Administrator of the National Aeronautics and Space Administration and the Director of the National Science Foundation, shall develop a formal mechanism to communicate the operational needs of space weather forecasters to the research community.

"(e) TECHNOLOGY DEVELOPMENT.—

"(1) FINDINGS.—Congress finds that observations and measurements closer to the Sun and advanced instrumentation would provide for more advanced warning of space weather disturbances (as defined in section 3 of the Space Weather Research and Forecasting Act).

"(2) TECHNOLOGY AND INSTRUMENTATION DEVELOPMENT.—The Administrator of the National Aeronautics and Space Administration and the Director of the National Science Foundation shall support the development of technologies and instrumentation to improve space weather forecasting lead-

time and accuracy to meet the needs identified by the Administrator of the National Oceanic and Atmospheric Administration.

"§ 60704. Space weather data

"(a) IN GENERAL.—The Administrator of the National Aeronautics and Space Administration and the Director of the National Science Foundation shall—

"(1) make space weather related data obtained for scientific research purposes available to space weather forecasters and operations centers; and

"(2) support model development and model applications to space weather forecasting.

"(b) RESEARCH.—The Administrator of the National Oceanic and Atmospheric Administration shall make space weather related data obtained from operational forecasting available for scientific research.".

(b) TECHNICAL AND CONFORMING AMENDMENTS.—

(1) REPEAL OF SECTION 809.—Section 809 of the National Aeronautics and Space Administration Authorization Act of 2010 (42 U.S.C. 18388) and the item relating to that section in the table of contents under section 1(b) of that Act (124 Stat. 2806) are repealed.

(2) TABLE OF CHAPTERS.—The table of chapters of title 51, United States Code, is amended by

adding after the item relating to chapter 605 the following:

"607 . Space weather ..... 60701".

SEC. 3. SPACE WEATHER METRICS.

(a) DEFINITIONS.—In this section:

(1) SPACE WEATHER DISTURBANCE.—The term "space weather disturbance" includes geo-electric fields, ionizing radiation, ionospheric disturbances, solar radio bursts, and upper atmospheric expansion.

(2) SPACE WEATHER BENCHMARK.—The term "space weather benchmark" means the physical characteristics and conditions describing the nature, frequency, and intensity of space weather disturbances.

(b) BENCHMARKS.—

(1) PRELIMINARY.—Not later than 90 days after the date of enactment of this Act, the Space Weather Interagency Working Group, established under section 60701 of title 51, United States Code, in consultation with academic and commercial experts, shall—

(A) assess existing data, the historical record, models, and peer-reviewed studies on space weather; and

(B) develop preliminary benchmarks, based on current scientific understanding and the historical record, for measuring solar disturbances.

(2) FINAL.—Not later than 18 months after the date the preliminary benchmarks are developed under paragraph (1), the Space Weather Interagency Working Group shall publish final benchmarks.

(3) REVIEW.—The Administrator of the National Aeronautics and Space Administration shall contract with the National Academy of Sciences to review the benchmarks established under paragraph (2).

(4) REVISIONS.—The Space Weather Interagency Working Group shall update and revise the final benchmarks under paragraph (2), as necessary, based on—

(A) the results of the review under paragraph (3);

(B) any significant new data or advances in scientific understanding that become available; or

(C) the evolving needs of entities impacted by solar disturbances.

SEC. 4. PROTECTION OF CRITICAL INFRASTRUCTURE.

(a) IN GENERAL.—The Administrator of the National Oceanic and Atmospheric Administration, in consultation with the heads of other relevant Federal agencies, shall provide information about space weather hazards to the Secretary of Homeland Security for purposes of this section.

(b) CRITICAL INFRASTRUCTURE.—The Secretary of Homeland Security, in consultation with sector-specific agencies, the Administrator of the National Oceanic and Atmospheric Administration, and the heads of other relevant agencies, shall—

(1) include, in meeting national critical infrastructure reporting requirements, an assessment of the vulnerability of critical infrastructure to space weather events, as described by the space weather benchmarks under section 3; and

(2) support critical infrastructure providers in managing the risks and impacts associated with space weather.

(c) PROHIBITION ON NEW REGULATORY AUTHORITY.—Nothing in subsection (b) may be construed to grant the Secretary of Homeland Security any authority to promulgate regulations that was not in effect on the day before the date of enactment of this Act.

(d) DEFINITION OF SECTOR-SPECIFIC AGENCY.—In this section, the term "sector-specific agency" has the meaning given the term in Presidential Policy Directive–21 of February 12, 2013 (Critical Infrastructure Security and Resilience), or any successor.

SEC. 5. PROTECTION OF NATIONAL SECURITY ASSETS.

(a) IN GENERAL.—The National Security Council, in consultation with the Office of the Director of National Intelligence, the Secretary of Defense, and the heads of other relevant Federal agencies, shall—

(1) assess the vulnerability of the national security community to space weather events, as described by the space weather benchmarks under section 3; and

(2) develop national security mechanisms to protection national security assets from space weather threats.

(b) COOPERATION.—The Secretary of Defense, in consultation with the heads of other relevant Federal agencies, shall provide information about space weather hazards to the National Security Council, Director of National Intelligence, and heads of Defense Agencies for purposes of this section.

SEC. 6. ENSURING THE SAFETY OF CIVIL AVIATION.

(a) IN GENERAL.—The Administrator of the Federal Aviation Administration, in consultation with the heads of other relevant Federal agencies, shall—

(1) assess the safety implications and vulnerability of the national airspace system by space weather events, as described by the space weather benchmarks under section 3;

(2) assess methods to mitigate the safety implications and effects of space weather on aviation communication systems, aircraft navigation systems, satellite and ground-based navigation systems, and potential health effects of radiation exposure; and

(3) assess options for incorporating space weather into operational training for pilots, cabin crew, dispatchers, air traffic controllers, meteorologists, and engineers.

(b) SPACE WEATHER COMMUNICATION.—The Administrator of the Federal Aviation Administration, in consultation with the heads of other relevant Federal agencies, shall develop methods to increase the interaction between the aviation community and the space weather research and service provider community.