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September 4, 2019

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Submission to the Inquiry into the Prerequisites for Nuclear Energy in Australia

Dear Secretariat:

I write on behalf of the nearly 9,000 men and women of the American Nuclear Society (ANS) to express our support for your inquiry into the prerequisites for nuclear energy in Australia. The inquiry is an important exercise to undergo in Australia's pursuit of affordable and reliable energy while fulfilling emissions reduction obligations.

Nuclear energy delivers economically-competitive electricity with no greenhouse gas emissions during electricity generation operations and has among the lowest lifecycle greenhouse gas emissions of any energy source. Nuclear energy is the only energy technology with worldwide potential for growth that has a proven record of delivering large amounts of reliable electricity without greenhouse gas emissions.

Nuclear energy not only provides clean electricity but can also provide process-heat and onsite electricity for a variety of beneficial applications, such as district heating, desalination, hydrogen production, and industrial processes. Nuclear plants can coordinate with variable, renewable generators to maximize the contribution of clean energy in meeting our needs across all sectors. This coordination allows nuclear plants to ensure a reliable around-the-clock electricity supply, while providing alternative revenue streams during periods in which there is a high availability of electricity from intermittent sources.

Nuclear energy (which provides much of the U.S. non-emitting electricity generation) has a crucial role to play in addressing the global need to reduce emissions. This is being recognized within the United States through legislation on the federal and state levels. Several states have enacted policies that compensate electricity generators for producing electricity without emitting greenhouse gases, which help to properly value electricity that is generated by nuclear plants and support nuclear plants that may be facing closure due to economics.

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The U.S. has expanded our federal engagement in advanced, non-light-water nuclear research and development. The Nuclear Energy Modernization Act, recently passed into law, requires the U.S. Nuclear Regulatory Commission to develop new processes for licensing nuclear reactors, including staged licensing of advanced nuclear reactors.

In the future, both small modular reactors (SMRs) and advanced nuclear power reactors will be attractive energy sources. SMRs have lower capital costs and require shorter construction time in comparison to large light water reactors. SMRs are especially suitable for remote areas with limited infrastructure. Deployment of small modular reactors to remote locations could not only provide power, but also produce hydrogen to serve as a clean fuel for transportation and heating. Advanced reactors often combine existing features of conventional nuclear power, such as resilience, reliability, and high capacity factors, with other features, such as enhanced load-following, microgrid generation, online refueling, and extended periods of uninterrupted operation. Advanced reactors may also provide higher temperatures and thermodynamic efficiencies. Once high temperature reactors become available, the spectrum of applications can be broadened to additional methods of hydrogen production, coal gasification, synthetic fuel production, and other industrial petrochemical applications. These features will enable SMRs and advanced reactors to play a central role in creating a low-emission energy grid.

The transportation of radioactive materials in the U.S. has been conducted with an excellent safety record. Millions of shipments of radioactive materials have taken place in the U.S. over the last five decades—by road, rail, sea, and air—at the rate of about three million per year. U.S. regulations governing shipments of radioactive waste are effective and consistent with International Atomic Energy Agency safety standards, and studies of the risk posed by the transportation of radioactive materials have repeatedly confirmed that current regulations protect public health and safety.

The successful operating experience to date demonstrates that storage of used nuclear fuel at nuclear power plant sites has been, and can continue to be, achieved in a safe and environmentally sound manner. As of 2016, the U.S. nuclear industry had loaded and placed into service over 2300 dry storage systems at 68 locations in 33 states since 1986. Plant workers, the public, and the environment have been effectively protected in every case.

The international community recognizes nuclear technology's potential to deliver clean energy. ANS, along with more than 40 other nuclear societies representing 80,000 scientists, signed a Declaration that was presented at the International Congress on Advances in Nuclear Power Plants (ICAPP), in Juan-les-Pins, France in May 2019 that emphasizes the importance of nuclear power being included as part of the clean energy portfolio of the future. ANS also participates in the Nuclear4Climate initiative, which, since it was founded in 2015 in preparation of COP21 in Paris, has grown to more than 160 nuclear organizations around the world.

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As the world recognizes the need to decarbonize our energy supply, combustion processes will be replaced by non-emitting processes to generate electricity and energy for transportation and industrial sectors. Nuclear power should be a key element of the effort to meet the need for non-emitting energy production.

Sincerely,

Marilyn C. Kray,
President, American Nuclear Society

Enclosures:

Nuclear Technology's Critical Role in the World's Future Energy Supply **(ANS-43-2019)**

Nuclear Energy's Role in Climate Change Policy (**ANS-44-2019**)

Nuclear for Climate Position Paper, November 14, 2018.

UN Climate Change Conference (COP21) Platform, Paris, 2015

Declaration from Nuclear Societies, May 13, 2019, Juan-Les-Pins, France.

The Safety of Transporting Radioactive Materials (**ANS-18-2017**)

Interim Storage of Used or Spent Nuclear Fuel (**ANS-76-2017**)

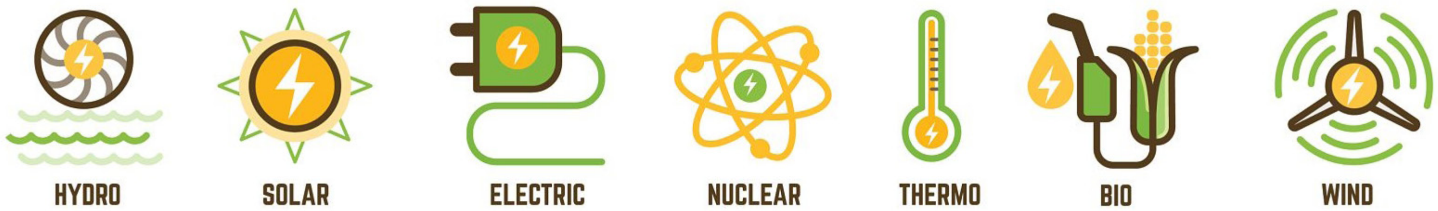
Small Modular Reactors (**ANS-25-2011**)

Advanced Reactors (**ANS-35-2018**)

U.S. Commercial Nuclear Power Plants: A Vital National Asset (**ANS-26-2017**)

Position Statement #43

Nuclear Technology’s Critical Role In The World’s Future Energy Supply



Nuclear power is a key component of electricity production. However, electricity is only one facet of overall energy use, and the future will require clean, affordable energy for transportation, industrial production, and other applications. Currently, nuclear energy is primarily used to generate baseload electricity for the grid. But nuclear energy can also provide process-heat and onsite electricity for a variety of beneficial applications, such as district heating, desalination, hydrogen production, and industrial processes.

Because nuclear plants provide clean, baseload electricity, they can coordinate with variable,

renewable generators to maximize the contribution of clean energy in meeting our needs across all sectors. This coordination and integration allows nuclear plants to ensure a reliable around-the-clock electricity supply, while providing alternative revenue streams during periods in which there is a high availability of relatively inexpensive electricity from intermittent sources.

For example, on sunny or windy days when solar or wind is abundant, the excess heat and electricity from nuclear plants can be repurposed for other uses, reduced through flexible operations, or stored for later use.

Transportation and industrial sectors together, account for a majority of the primary energy consumption in industrialized societies. Burning fossil fuels produces most of this energy.

Addressing climate change requires a shift toward energy technologies that generate less carbon dioxide and other greenhouse gases. Furthermore, future energy systems will likely have to meet stricter emissions limits on atmospheric pollutants such as sulfur oxides, nitrogen oxides, mercury, heavy metals, and particulates. Nuclear plants do not emit these pollutants.

In summary, nuclear plants can provide heat and energy for many uses with minimum environmental impacts. To achieve this, the following is required:

- Collaboration between federal government research and development entities, international entities, and organizations, electricity generators, reactor developers, and industrial customers, including the development of modeling tools to assess technical and economic viability of integrated energy systems, and the design of experiments to demonstrate the necessary interfaces, controls, and operations.
- Economic research into the valuation, market structure, and ability to finance such integrated systems.
- Policy incentives that will support initial commercial deployment of integrated energy systems and properly value them in the marketplace.

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Position Statement #44

Nuclear Energy's Role in Climate Change Policy

The consensus of the international community of climate scientists is that humans are influencing the global climate.[1] While the state of climate science is still maturing, the American Nuclear Society (ANS) believes that the risks presented by rising temperatures are sufficient to warrant enactment of policies designed to limit emissions of greenhouse gases into the atmosphere as a means of abating these risks.[2] ANS therefore supports the principal objective of recent international agreements on carbon dioxide emission reductions, along with state and federal initiatives designed to reduce greenhouse gas emissions from human activities.

ANS supports policies designed to reduce greenhouse gas emissions that are performance-based and technology-neutral. Nuclear energy (which provides much of the U.S. non-emitting generation) should be considered on the same basis as other non-emitting energy technologies. ANS believes that nuclear energy has a crucial role to play in addressing the global need to reduce emissions. Policies should evaluate energy sources based upon their ability to contribute reliably to meeting emission-reduction targets. ANS's recommended role for nuclear energy is consistent with recommendations by the Nuclear for Climate Initiative.[3] by the Declaration from Nuclear Societies,[4] and by the International Panel on Climate Change.[1]

Nuclear energy delivers economically competitive electricity with no greenhouse gas emissions during electricity generation operations and has among the lowest lifecycle greenhouse gas emissions of any energy source.[5] Nuclear energy is the only energy technology with worldwide potential for growth that has a proven record of delivering large amounts of reliable electricity without greenhouse gas emissions. ANS believes that nuclear energy is an important tool in reducing emissions and will make major contributions under well-composed technology-neutral emission-reduction policies.

Several states have enacted policies that compensate electricity generators for producing electricity without emitting greenhouse gases (e.g., zero-emission credit programs).[6] ANS supports these policies, which recognize the value of nuclear energy in a reliable, affordable, low-emission electric power system. Unfortunately, some governments have mandated preferential treatment for specific technologies and/or fuel sources (e.g., wind and solar) but have not provided comparable support for nuclear energy despite its ability to reduce carbon emissions.

Performance-based policies, which clearly define the outcome as opposed to selecting the technology, help to properly value electricity that is generated by nuclear plants and support nuclear plants that may be facing closure due to economics.[7,8] ANS has developed a "Nuclear in the States Toolkit" that outlines policies related to new and existing nuclear reactors for policymakers to consider as they develop policies to reduce emissions.[9]

ANS recognizes the value of energy diversity and believes that other energy technologies should be deployed as appropriate while acknowledging the full range of benefits and drawbacks associated with each technology. For example, the need for dispatchable backup electricity generation capacity, such as natural gas or energy storage capabilities, must be considered for intermittent generation sources, such as solar and wind. Further, attributes like reliability, resilience, and land use requirements constrain the contributions of inherently diffuse energy sources.[10] In all cases, policymakers should base energy generation choices on the complete set of attributes of energy technologies.

As the world recognizes the need to decarbonize our energy supply, combustion processes will be replaced by non-emitting processes to generate electricity. Nuclear power should be a key element of the effort to meet the need for non-emitting electricity production.

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Photo credit: http://ncesse.org/content/engaging-reading/

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NUCLEAR FOR CLIMATE DECLARATION

Nice – France
4 May, 2015

WE THE UNDERSIGNED,

Scientists, engineers, and professionals representing regional, national and international scientific societies, as well as numerous technical organizations dedicated to the development and peaceful use of nuclear technology,

Gathered here today in Nice - France

ACKNOWLEDGE the unequivocal conclusions reached by the majority of climatologists, as stated in the peer reviewed Fifth Assessment Report of the International Panel on Climate Change (IPCC) that "human activities have contributed to changes in the Earth's climate";

are HOPEFUL in regards to the outcomes of the Climate Change Conference that will take place in Paris in December 2015 - COP 21 (Conference of Parties);

COGNISANT of the fact that, according to OECD (Organisation for Economic Cooperation and Development), while the global population is expected to reach about 10 billion, with increasing development, electricity demand is currently on track to double by 2050;

SHARE the objective of limiting global warming to a maximum of 2°C by 2050, which will require, according to IPCC, 80% of electricity to come from low-carbon sources by that time (up from only 30% now);

are CONSCIOUS that this presents a massive challenge which will require the deployment of all available low-carbon technologies;

are CONVINCED that the world needs to take immediate steps to reduce greenhouse gas emissions, as a large share of the carbon budget has already been consumed, and that we cannot wait for future technologies to be ready for deployment before launching our decarbonisation efforts;

RECOGNIZE that nuclear energy is one of handful of options available at scale which can help to reduce energy related greenhouse gas emissions, and would emphasise that this view is shared by the OECD (Organisation for Economic Cooperation and Development) and IPCC.

Hereby declare that

WE PROUDLY BELIEVE THAT NUCLEAR ENERGY IS A KEY PART OF THE SOLUTION IN THE FIGHT AGAINST CLIMATE CHANGE

and BELIEVE that each country needs access to the widest possible portfolio of low-carbon technologies available, including nuclear energy, in order to reduce CO2 emissions and meet other energy goals;

CALL FOR the new UNFCCC (United Nations Framework Convention on Climate Change) Protocols to recognize nuclear energy as a low-carbon energy option, and to include it in its climate funding mechanisms, as is the case for all other low-carbon energy sources.

have DECIDED to jointly sign this declaration and would like to bring it to the attention of decision-makers.

PLATFORM

UN Climate Change Conference (COP21) Paris, 2015

Background

The American Nuclear Society (ANS) recognizes that the earth's climate has changed. Human activities, notably the production of greenhouse gases, have contributed to this phenomenon. The risks presented by rising temperatures across the globe are sufficiently large to justify enactment of policies at the national and international levels.

ANS supports global policies designed to address carbon emission reductions that are performance-based and technology neutral. Carbon-reduction policies should not explicitly privilege any one energy source over another. Instead, such policies should evaluate energy sources based upon their ability to reliably contribute to meeting carbon reduction goals.

Nuclear energy has a crucial role to play in addressing the global need for reduced emissions from energy generation. The increased use of nuclear energy in offsetting the use of fossil fuels where appropriate offers an effective means of reducing global carbon emissions.

ANS recognizes the value of energy diversity and believes that other low-carbon energy technologies (such as wind, solar, and hydro) should be deployed as appropriate, while recognizing the benefits and drawbacks associated with each technology. However, with the exception of hydro, renewable sources are limited by their intermittency, requirement of backup power generation and storage capabilities. It is essential that policymakers recognize that nuclear energy delivers large amounts of reliable, economically competitive electricity with no carbon emissions during reactor operations, and has among the lowest lifecycle carbon emissions of any energy source.[1]

The ongoing global climate talks taking place during COP21 are aimed at reducing carbon emissions from all sources. Significantly reducing carbon emissions while meeting the world's growing energy demands must include nuclear as a major provider of zero carbon energy. Nuclear energy demonstrates its capabilities as a baseload provider of carbon-free energy by producing:

- 11% of global electricity
- 27% of Europe's electricity
- 53% of global carbon-free electricity
- 20% of U.S. electricity

According to the latest World Energy Outlook published by the International Atomic Energy Agency (IAEA), nuclear energy has already avoided the release of around 56 Gt of CO_2 since 1971, which is equivalent to two years of emissions at current rates. By 2040, it is forecast to avoid the release of almost four years of CO_2 emissions at current rates.

American Nuclear Society UNFCCC/COP21 Platform

To meet proposed global warming goals (below 2° C), it is essential that the United Nations Framework Convention on Climate Change (UNFCCC COP21/CMP11) agreement:

1. Is performance-based and technology neutral.
2. Does not favor any individual energy technology over others.
3. Includes nuclear among the clean energy sources available to meet carbon reduction goals.

4. Encourages and allows nations to make independent decisions about their energy portfolios.
5. Ensures that every nation has the freedom and ability to choose from all available energy sources offering the lowest lifecycle carbon emissions.
6. Facilitates the continuation, expansion and creation of new international clean energy technology advancements by preserving the inclusion of all possible energy options for ensuring that global climate protection goals are reached.
7. Include nuclear in climate funding mechanisms, as is the case for all other low-carbon energy sources.

References

1. American Nuclear Society Position Statement #44, Nuclear Energy's Role in Climate Change Policy, 2013

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DECLARATION FROM NUCLEAR SOCIETIES

MAY 13, 2019
JUAN-LES-PINS, FRANCE

WE THE UNDERSIGNED,

Women and men scientists, engineers, and professionals representing national, regional and international scientific societies, as well as numerous technical organizations dedicated to the development and peaceful use of nuclear technologies,
Gathered here today in Juan-les-Pins – France

ABOUT THE FUTURE ROLE OF NUCLEAR ENERGY:

AGREE that climate change is the most significant threat to our planet today, and with the objectives of the Paris Agreement to limit global warming by the end of this century to well below 2 degrees Celsius above pre-industrial levels, with further efforts to limit the increase to 1.5 degrees Celsius.

ARE CONCERNED that the world is not progressing quickly enough in meeting this goal.
• The latest Intergovernmental Panel on Climate Change (IPCC) report sends a clear warning that the 1.5°C temperature increase may be exceeded already by 2030.
• According to the International Energy Agency (IEA), in 2018 global energy-related CO_2 emissions rose 1.7% to a historic high of 33.1 Gt CO_2.

REMIND that:
• Nuclear energy is recognized as one of the lowest carbon sources of electricity. According to the IPCC , the median lifecycle emissions from nuclear energy are 12g/kWh, similar to wind energy.
• International institutions (United Nations, Organization for Economic Cooperation and Development, European Union) believe that all low-carbon technologies (renewable, nuclear and carbon capture & storage) will need to be implemented in order to achieve deep decarbonization by the middle of this century. This is reflected in the latest 2018 IPCC report: the four 1.5°C illustrative pathways in the Summary for Policymakers include more nuclear energy, with a two-fold to six-fold increase in the use of nuclear power by 2050.

ABOUT THE NEED FOR INNOVATION FOR NUCLEAR ENERGY:

NOTE that:
• There is global consensus that accelerating clean energy innovation is essential for limiting the rise in global temperatures, and some progress has been made in that direction: according to the IEA, the amount of public R&D investment in clean energy has doubled since 2000. Also, the launch of the Mission Innovation initiative in 2015 includes the objective of another doubling of the investment for low-carbon energy research by the 2020 timeframe.

HIGHLIGHT that:
• The current level of public support for nuclear R&D (fission and fusion) has remained constant around 4 billion USD per year (in 2014 value) since 2000, in a “business as usual” situation. Additionally, in many countries, the private sector has been less eager to invest in nuclear R&D, for a variety of reasons including mixed or negative political signals, electricity market designs that have had a negative impact on the business case for nuclear energy, and perceptions on the level of financial risk required to be taken by private investors.

POINT OUT that:
• The nuclear industry is currently undertaking a new wave of creative projects around innovative reactor technologies (e.g. Small Modular Reactors, Gen IV reactors), cross-cutting technologies (e.g. digital transformation) and new applications (e.g. desalination, district heating, process heat for industry, hydrogen production), all requiring significant R&D investment and new innovative approaches.
• These projects are expected to open new market opportunities for the use of nuclear power together with other clean energy sources, often in sectors where they can make a decisive contribution to the decarbonization effort (e.g. the heating sector)
• At the same time, a large proportion of the R&D infrastructure is becoming obsolete and needs to be renewed not only to support the development of this new wave of innovative reactors, but also to produce the radioisotopes needed for the development of nuclear medicine.

Hereby declare that

WE ASK
THAT THE CLEAN ENERGY MINISTERIAL CONFERENCE
TAKE NUCLEAR INNOVATION TO BROAD MULTILATERAL DISCUSSIONS ON CLEAN ENERGY AT BOTH THE MINISTERIAL AND WORKING LEVELS, SO THAT NUCLEAR ENERGY CAN MAKE ITS FULL EXPECTED CONTRIBUTION, AS PART OF THE CLEAN ENERGY PORTFOLIO, TOWARDS DECARBONIZATION GOALS.
COMMIT TO A DOUBLING OF PUBLIC INVESTMENT IN NUCLEAR-RELATED R&D AND INNOVATION WITHIN THE NEXT 5 YEARS, WITH A FOCUS ON INNOVATIVE APPLICATIONS OF ADVANCED NUCLEAR SYSTEMS TO ENABLE THE CLEAN ENERGY MIX OF THE FUTURE

And

Have DECIDED to jointly sign this declaration and would like to bring it to the attention of decision-makers internationally.

NUCLEAR SOCIETIES

AATN

HND — Hrvatsko Nuklearno Društvo — Croatian Nuclear Society

AIN — Associazione Italiana Nucleare

Netherlands Nuclear Society

SGK SNS — Schweizerische Gesellschaft der Kernfachleute — Swiss Nuclear Society

PTN

NMD

Australian Nuclear Association

Čns — Česká nukleární společnost

Atomic Energy Society of Japan

Asociația Română Energia Nucleară

Українське ядерне товариство

ÖKTG — Österreichische Kerntechnische Gesellschaft

ATS — Suomen Atomiteknillinen Seura - Atomtekniska Sällskapet i Finland r.y. — Finnish Nuclear Society

Ядерное общество Казахстана — Ассоциация

Ядерное общество России

the nuclear institute

BNS — Belgian Nuclear Society

SFEN — Société Française d'Energie Nucléaire

BEA

SNUS

American Nuclear Society

ABDAN

KTG — Faszination Kerntechnik

MNS

Nuclear Society of Slovenia — Društvo jedrskih strokovnjakov Slovenije

ENS — European Nuclear Society

Bulgarian Nuclear Society

mnt

AIGAM

KNS — Korean Nuclear Society

ENS YGN

Canadian Nuclear Society — Société Nucléaire Canadienne

Indian Youth Nuclear Society

SNM — Sociedad Nuclear Mexicana

SNE — Sociedad Nuclear Española

INSC — International Nuclear Societies Council

CNS

Israel Nuclear Society — I.N.S

MNS

SKS — Sveriges Kärntekniska Sällskap — Swedish Nuclear Society

International Youth Nuclear Congress

NUCLEAR SOCIETIES

ARGENTINA
Asociación Argentina de Tecnología Nuclear

AUSTRALIA
Australian Nuclear Association

AUSTRIA
Österreichische Kerntechnische Gesellschaft

BELGIUM
Belgian Nuclear Society

BRASIL
Associação Brasileira para Desenvolvimento Atividades Nucleares

BULGARIA
Bulgarian Nuclear Society

CANADA
Canadian Nuclear Society

CHINA
Chinese Nuclear Society

CROATIA
Croatian Nuclear Society

CZECH REPUBLIC
Czech Nuclear Society

FINLAND
Finnish Nuclear Society

FRANCE
French Nuclear Society

GERMANY
Kerntechnische Gesellschaft e.V.

HUNGARY
Hungarian Nuclear Society

INDIA
Indian Youth Nuclear Society

ISRAEL
Israel Nuclear Society

ITALIA
Associazione Italiana Nucleare

JAPAN
Atomic Energy Society of Japan

KAZAKHSTAN
Nuclear Society of Kazakhstan

LITHUANIA
Lietuvos Branduolinės Energetikos Asociacijos

MALAYSIA
Malaysian Nuclear Society

MOROCCO
Association des Ingénieurs en Génie Atomique

MEXICO
Sociedad Nuclear Mexicana

MONGOLIA
Mongolian Nuclear Society

NETHERLANDS
Netherlands Nuclear Society

POLAND
Polskie Towarzystwo Nukleoniczne

ROMANIA
Asociatia Romana „Energia Nucleara"

RUSSIA
Nuclear Society of Russia

SLOVAKIA
Slovak Nuclear Society

SLOVENIA
Nuclear Society of Slovenia

SOUTH KOREA
Korean Nuclear Society

SPAIN
Sociedad Nuclear Espanola

SWEDEN
Swedish Nuclear Society

SWITZERLAND
Swiss Nuclear Society

TURKEY
Nuclear Engineers Society of Turkey

UKRAINE
Ukrainian Nuclear Society

UNITED KINGDOM
Nuclear Institute

UNITED STATES OF AMERICA
American Nuclear Society

ENS
European Nuclear Society

ENS-YGN
ENS - Young Generation Network

INSC
International Nuclear Society Council

IYNC
International Youth Nuclear Congress

American Nuclear Society

Position Statement #18

The Safety of Transporting Radioactive Materials

Millions of shipments of radioactive materials have taken place in the United States over the last five decades—by road, rail, sea, and air—at the rate of about 3 million per year. Shipments of radioactive materials on public rights-of-way are regulated by the U.S. Department of Transportation and the U.S. Nuclear Regulatory Commission; these regulations are effective and consistent with International Atomic Energy Agency safety standards.[1, 2, 3] Taken together, the experience base and the mature regulatory oversight structure provide confidence that radioactive materials have been and will continue to be transported safely.

Transporting radioactive material is necessary to provide for the use, storage, processing, and disposal of the material. Federal regulations address packaging, radiation shielding, labeling, loading and unloading, storage, transportation routes, and vehicle requirements. They impose strict limits on external radiation from the transported package, on the amount of fissile material that can be transported, on the radiation exposure of workers and crews of transport vehicles, and on the amounts of radioactive materials that can be released to the environment. There are also requirements to protect against the diversion of radioactive materials. All shippers and carriers are licensed, and all storage and shipping containers are certified. A graded approach is taken to regulations, so that the greater the potential radiological hazard of the material being shipped, the more stringent the packaging safety requirements. Packages containing material with the highest levels of radioactivity, such as used nuclear fuel (UNF) and high-level radioactive waste (HLW), must demonstrate their ability to withstand hypothetical accident conditions, including a high-speed impact simulated by a 30-foot drop onto an unyielding surface, 30 minutes in a completely engulfing fire at 1475°F (800°C), and immersion under 50 feet of water.

Studies of the risk posed by the transportation of radioactive materials have repeatedly confirmed that current regulations protect public health and safety. The 1977 environmental impact statement on radioactive materials transportation, NUREG-0170,[4] concluded that existing regulation protects public health and the environment. This result was confirmed most recently by NUREG-2125,[5] published in 2014. In addition, NUREG-2125 estimated that (1) over 99.999 percent of accidents that could involve a UNF shipment would have no impact at all on the cargo, and (2) the amount of ionizing radiation exposure to the public along the transportation route from a routine, incident-free UNF shipment would be a negligible fraction of annual background ionizing radiation.

More than 4,000 shipments of UNF have been made over U.S. highways and railroads since 1964.[6] Moreover, the U.S. Department of Energy has transported to the Waste Isolation Pilot Project in New Mexico nearly 12,000 shipments of transuranic waste over 14 million miles since 1999 without incident.[7] The environmental impact statement for the proposed Yucca Mountain repository (DOE/FEIS-0250),[8] published in 2002, estimated that if UNF were to be transported to the repository primarily by truck, about 2,200 shipments per year over a 24-year period would be needed to support Yucca Mountain. This would constitute an increase of less than 0.1 percent over the current number of radioactive shipments and less than 0.0007 percent of the 400 million shipments of hazardous materials taking place per year in the United States. If UNF were to be transported primarily by rail, even fewer shipments would be required. Analyses demonstrate that the projected shipments of UNF to a consolidated storage facility or a repository can be accomplished without adding any significant radiological risk to the population along the shipping routes. International experience supports this conclusion. Outside of the United States, in the past

50 years, at least 20,000 shipments of UNF and HLW totaling at least 80,000 tons of material have been made safely.[6]

There have been a few instances in which shipments of UNF or HLW have been involved in transportation accidents.[6] While extremely rare, severe accidents have taken place, including a trailer hauling UNF overturning, and a grade-crossing accident involving a train carrying UNF. In each case, the packages performed as they were designed. The UNF cargo was not damaged, the material was contained within the package, and the health and safety of the public was not put at risk from the radioactive material.

The transportation of radioactive materials in the United States and worldwide has been conducted with an excellent safety record. The historical record of shipments of radioactive material has demonstrated that the regulations currently in place are sufficient to protect the health and safety of the public and the environment. Furthermore, an increase in the number of radioactive materials shipments, specifically of UNF shipments to a consolidated storage facility and/or repository, would not present any additional radiological risk, when compared to the natural background radiation, or any adverse impact to the public or the environment. ANS is confident that the current regulations are adequate and sufficient to protect the health and safety of the public and the environment in the future. ANS supports the continued safe transportation of radioactive materials under the current regulatory structure.

Reference

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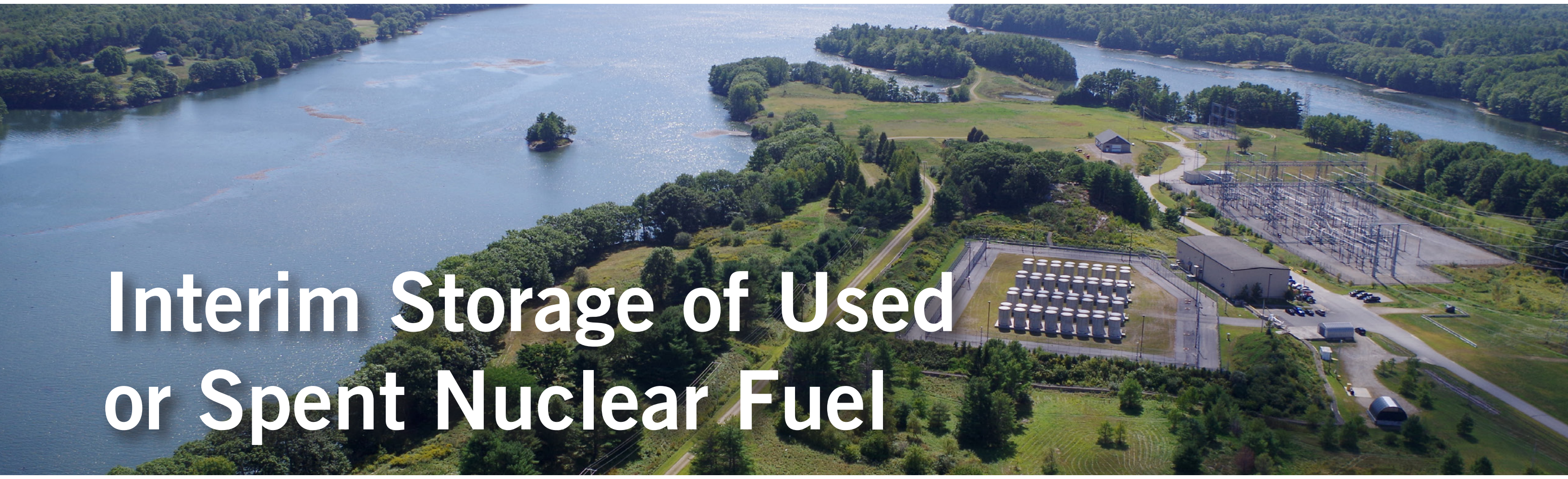
Position Statement #76

Interim Storage of Used or Spent Nuclear Fuel



The American Nuclear Society (ANS) endorses interim storage of irradiated fuel from a nuclear power reactor (commonly referred to as spent or used nuclear fuel, and referred to herein by the acronym UNF) until final disposal is completed. In the United States, the Nuclear Regulatory Commission (NRC) is the licensing and regulatory authority for used fuel management.

Newly discharged UNF is stored underwater in pools at reactor sites. As these pools approach capacity limits, the UNF is transferred into robust metal or concrete and steel dry storage systems typically located on or near the reactor site in a facility commonly referred to as an Independent Spent Fuel Storage Installation (ISFSI). These relatively simple and passive dry storage systems protect against events that could result in radiological releases into the environment. The ISFSIs are monitored and secured to ensure continued protection.

As of 2016 the U.S. nuclear industry had loaded and placed into service over 2300 dry storage systems at 68 locations in 33 states since 1986[1]. Plant workers, the public, and the environment have been effectively protected in every case.

Current operational and decommissioned nuclear power plants in the U.S. were licensed with the expectation that the UNF would be stored at the nuclear power plant site for a short period of time until shipment to a recycling plant or geologic disposal facility for high-level radioactive waste. However, no facility capable of receiving UNF is operating in the U.S. and it is uncertain when one might become available. Therefore, utilities have been forced to store UNF at nuclear power plant sites in greater quantity and for longer time periods than originally envisioned.

ANS believes that the successful operating experience to date demonstrates that UNF storage at nuclear power plant sites has been, and can continue to be, achieved in a safe and environmentally sound manner.

As longer periods of storage become inevitable, the nuclear industry and NRC have placed an increased emphasis on assuring the long-term integrity of storage systems. This is being accomplished through aging management programs similar in scope to those that have been successfully deployed at more than 80% of the U.S. commercial nuclear reactor fleet (extending operations from 40 to 60 years, with periods of up to 80 years under consideration).

ANS believes that aging management programs for UNF storage will be as effective as those already applied to reactors. NRC's recent determination that the environmental impacts of continued storage of UNF are small supports this conclusion – as, in reaching this conclusion, the NRC examined storage periods of as long as 100 years without any repackaging of the UNF[2].

Nevertheless, interim storage of UNF is a partial and temporary answer to managing the UNF produced by nuclear power reactors. ANS supports the ultimate development of recycling (see *Position Statement 45, Nuclear Fuel Recycling*) and geologic disposal (see *Position Statement 80, Licensing of Yucca Mountain as a Geologic Repository for Used Nuclear Fuel and High-Level Radioactive Waste*).

Until recycling and/or geologic disposal can be accomplished, ANS also supports the development of consolidated away from reactor interim storage for UNF – in most cases using the same proven technology now deployed at reactor sites[3]. Consolidation could result in a more efficient storage system (as aging management and security capabilities could be combined for a larger number of systems). It would also allow land which is currently being used to store UNF at decommissioned reactors to be returned to surrounding communities for other purposes. Away from reactor consolidated storage facilities have been safely operated for decades in Europe, using both wet (pool) storage and dry storage technology.

Until recycling and/or disposal facilities are in operation, the interim storage of UNF can continue under current controlled conditions – in pools and casks at either reactor or consolidated sites.

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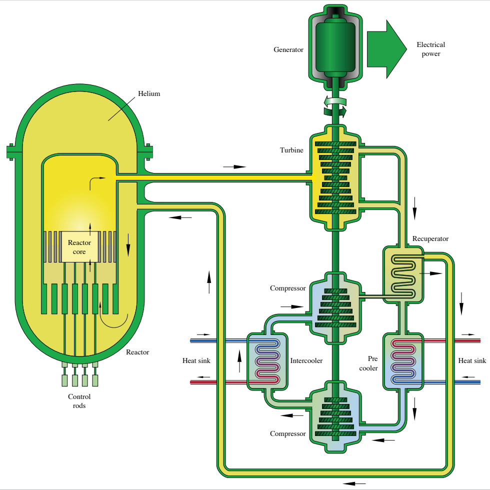
Position Statement #25

Small Modular Reactors



Small Modular Reactors (SMRs)[1] are considered to be nuclear reactors with power levels less than or equal to 300 MWe. Some of these reactors are designed to stand alone and some can be deployed as "modules", allowing add-on capacity after the initial module goes into operation. Like larger reactors, they use safe, proliferation-resistant technologies.

Generally speaking, SMRs have the following advantages:

- Use manufacturing capability currently available in the U.S.;
- Have lower capital cost with reduced debt profile;
- Require shorter construction time;
- Are deployable in markets in the U.S. and abroad that cannot accommodate or afford large reactors;
- Meet some mission requirements for government and military applications; and
- Provide electricity to remote populated areas such as in the northern latitudes.

In addition, SMRs can be used for the following specific low-carbon applications:

- Scalable electricity generation;
- Scalable industrial applications, such as:
- Electricity production for transportation,
- Synthetic fuel production for transportation (high-temperature reactor designs),
- Extraction of oil from tar sands (high-temperature reactor designs), and
- Production of fresh water by desalination; and
- Scalable back-end fuel cycle support.

The American Nuclear Society (ANS) has taken a leadership role[2] in addressing licensing issues for SMRs.

The licensing and eventual deployment of SMRs could lead to:

- Job creation,
- Potential opportunities to export SMRs as well as supporting technologies and services, and
- Opportunities to incorporate proliferation-resistant features into SMR designs and manufacturing.

The United States has built small reactors since the 1950s with many land-based and sea-based platforms. These efforts have advanced the safety and security of light water–cooled, gas-cooled, and liquid metal–cooled SMR technologies.

The American Nuclear Society recommends the following actions by the U.S. government:

- Expedite research on issues which must be addressed prior to commercial deployment of SMRs for flexible and scalable electricity generation applications,
- Enable timely adoption of SMR designs by assisting in the identification and resolution of generic SMR licensing issues as well as by establishing the most efficient and effective licensing

approaches through interactions with all stakeholders and the Nuclear Regulatory Commission,

- Encourage the development and deployment of multiple SMR designs as part of a balanced energy mix and expand their use beyond electricity generation,
- Participate in programs that demonstrate the feasibility of multiple SMR designs and approaches to reduce the time to market, and
- Encourage increased manufacturing/export technology capability in the United States for both domestic deployment and worldwide export within the "123 Agreement Framework"[3] in order to increase the use of nuclear energy as part of a balanced energy mix.

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1. IAEA-TECDOC-1451, "Innovative small and medium sized reactors: Design features, safety approaches and R&D trends," May 2005.
2. "Interim Report of the ANS President's Special Committee on Small and Medium Sized Reactor (SMR) Generic Licensing Issues," July 2010.
3. Section 123 of the United States Atomic Energy Act of 1954, titled "Cooperation With Other Nations," establishes an agreement for cooperation as a prerequisite for nuclear deals between the United States and any other nation. Such an agreement is called a 123 Agreement.

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Position Statement #35

Advanced Reactors

The American Nuclear Society (ANS) promotes the development and deployment of advanced reactors because of their importance to the sustainability, reliability, and security of the world's long-term energy supply. Government and environmental groups recognize that nuclear energy has an essential role in providing clean, reliable electricity. Advanced reactor designs offer the benefits of current reactors as well as the potential to deploy in high-temperature industrial applications beyond electricity generation, inherent features that reduce complexity and enhance safety, and more efficient fuel use for long-term fuel supply sustainability. Advanced reactor development is proceeding worldwide with strong government backing. It is important that the United States be a global leader in the development of advanced reactors in order to achieve objectives in nuclear safety, security, and nonproliferation. Meaningful public policy actions are needed to ensure continued U.S. leadership in this vital sector.

Advanced reactors often use fuel types different from conventional uranium oxide and generally incorporate coolants such as liquid metal, gas, or molten salt. Attributes of advanced reactor designs will enable fission technology to extend beyond clean electricity production. The higher operating temperatures of many advanced non–light water reactor designs enable clean, carbon-free, and economical process heat applications, providing an alternative to the fossil fuels that are currently used for these applications. Most proposed advanced reactor designs either produce a lower volume of nuclear waste than current reactors or have the potential to consume nuclear waste as a source of fuel. Advanced reactors often combine existing features of conventional nuclear power, such as resilience, reliability, and high capacity factors, with other features, such as enhanced load-following, microgrid generation, online refueling, and extended periods of uninterrupted operation. These features will enable advanced reactors to play a central role in creating a low-emission energy grid, improving the economic performance of nuclear energy and increasing its market attractiveness.

Advanced reactors offer the promise of improved safety and economics as well as more flexible operations, maintenance, and surveillance through inherent system characteristics. A risk-informed and performance-based framework for design and regulation[1] will enable advanced reactors to realize reduced capital and operating costs through simpler designs that have fewer unnecessary requirements associated with fabrication, installation, maintenance, and testing of safety-related systems and components.

The American Nuclear Society recommends the following policy actions to foster the development of advanced reactors:

1. Use the capabilities of the U.S. Department of Energy infrastructure and international partners to perform vital fundamental research related to advanced reactors. While some designs are ready for deployment based on current technology, long-term advancements in applied science and engineering will enable advanced reactors to fully realize their potential. In particular, fast reactor designs would benefit significantly from a versatile fast neutron source for materials and fuels testing.

2. Establish private-public partnerships to build demonstration units for multiple advanced reactor designs. Demonstration reactors will provide operational experience and focus research and development on advancements needed to optimize designs for commercial deployment. Nuclear energy systems have high development costs and longer time frames than other energy sources, but their attributes justify the public funding needed to bring promising designs to fruition.

3. Support the ongoing development of a technology-neutral, risk-informed, and performance-based licensing framework that will provide effective and efficient regulation of advanced reactor designs.

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1. Risk-Informed and Performance-Based Regulations for Nuclear Power Plants (ANS-46-2017). http://cdn.ans.org/pi/ps/docs/ps46.pdf

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Position Statement #26

U.S. Commercial Nuclear Power Plants: A Vital National Asset

Photo courtesy of Exelon Corporation

The American Nuclear Society (ANS) believes that the sustained operation of the current nuclear fleet is vital to the continued security and economic prosperity of the United States and the world. U.S. nuclear power plants provide reliable clean energy, help diversify our electricity supply, and support continued U.S. influence over global safety and nonproliferation standards. However, many U.S. electricity markets fail to recognize and appropriately compensate operators for the valuable attributes of nuclear energy. This distortion has resulted in the premature shutdown of several U.S. nuclear power plants and has made the construction of new nuclear power plants financially challenging, potentially compromising the future reliability of the U.S. electricity system.

Nuclear energy provides about 20 percent of the electricity generated in the United States and avoids the emission of nearly 600 million metric tons of carbon dioxide annually, an amount roughly equivalent to the emissions of all passenger cars operating in the United States.[1] Nuclear power plants also avoid emissions of pollutants from fossil fuel generation such as sulfur dioxide (SOX), nitrogen oxides (NOX), and particulates, that can contribute to asthma and symptoms of other respiratory ailments.[2]

In addition, the U.S. nuclear industry directly provides significant numbers of high-paying jobs[3] and supports many more jobs indirectly. The closure of a nuclear power station results in the elimination of 400–700 jobs with salaries that are over 30 percent higher than those for similar jobs in other fields and the loss of at least $400 million in economic output to the surrounding community.[4]

Nuclear energy also contributes to fuel diversity for the U.S. electricity supply. High reliability and around-the-clock availability make nuclear power plants the ideal provider of the clean baseload electric power that is essential to support a modern industrial society. Nuclear plants have several distinct advantages over other forms of electricity generation, including on-site fuel supply and the ability to withstand extreme weather events such as hurricanes and extended cold weather (e.g., the 2014 polar vortex).[5]

The loss of additional operating nuclear power plants in the United States will reduce key capabilities of our domestic nuclear industry, particularly our capacity to export U.S. nuclear technology and, along with it, our world-leading safety and nonproliferation standards. The U.S. Nuclear Regulatory Commission is considered the gold standard of industrial safety regulators, and the U.S. nuclear fleet is the world leader in plant safety, reliability, and performance. American engineers and experts are involved in a wide range of projects worldwide and are valued by developing nations that are creating nuclear energy programs. These experts bring the U.S. safety culture and its focus on nonproliferation with them wherever they work, and in doing so they make the world a safer place. Maintaining this level of involvement and leadership requires a strong domestic nuclear fleet; we cannot develop and maintain the necessary professional talent without it. As a result, the health of our domestic nuclear power industry is a vital national security issue, and U.S. nuclear power plants are key national assets.

The American Nuclear Society recommends the following:

1. **Federal and state policies should be enacted to level the playing field between nuclear power and other clean energy generation technologies.** While solar and wind power provide carbon-free electricity, these generators operate only intermittently. At times of high wind or solar energy generation, these renewable sources can drive electricity market prices to zero, or below zero in some regions, reducing revenue for all other energy producers, including nuclear power plants. State and federal economic incentives provided to solar and wind power, but not to nuclear power, enable solar and wind projects to remain profitable at such times; these incentives should be extended to

include nuclear power. In addition, deregulated electricity markets focus on short-term electricity prices and do not fully compensate generators that support year-round reliability and grid stability. These electricity markets do not address long-term reliability issues well.

2. **State laws and electricity market rules should be adjusted to support nuclear power by the enactment of policies at the federal and state levels, as needed.** Electricity markets have implemented capacity side markets to help manage system reliability, but even the combination of electricity spot markets and capacity markets does not fully support the attributes of nuclear power. The electricity markets should, to the extent possible, reform their rules to ensure that spot market prices reflect the full cost of operation. Electricity market spot prices should be reformed to reflect the value of avoided emissions. Capacity markets should be reformed to provide longer-term revenue that will be consistent with power plant decision-making. Legislation should be enacted to allow for regional and state capacity planning using long-term bilateral contracts in states and regions with Federal Energy Regulatory Commission–regulated electricity markets.

3. **Support for nuclear power should include a greater role for the federal government.** The major nuclear industrial countries in the world (e.g., China, Russia, France, and South Korea) have nuclear power and nuclear supplier industries that are owned by the government and are used to achieve commercial success in the export markets. Even if nuclear power's electricity industry attributes are compensated, the U.S. nuclear power and nuclear supplier industries may not be able to compete with these government-owned nuclear industrial competitors. The U.S. federal government should have a role in helping the U.S. nuclear power and nuclear supplier industries remain competitive, as well as in communicating the important benefits that nuclear provides to our economy and to the environment.

Nuclear power plants have a vital role to play in the reliability of our electricity grid, our national energy independence, the health of our climate, and the achievement of global nuclear nonproliferation. The current U.S. nuclear fleet cannot support these objectives if its economic health is undermined by markets that do not recognize or compensate nuclear for the benefits it offers. The American Nuclear Society supports actions to bolster the current nuclear fleet and improve its economic future.

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