PETITION FOR RULE-MAKING BEFORE THE NUCLEAR REGULATORY COMMISSION FOR STANDARD DESIGN CERTIFICATIONS FOR NUCLEAR WASTE RECOVERY SYSTEMS

RESPECTFULLY SUBMITTED BY ALGIGNIS, INC., 2201 TOWNLEY ROAD, TOLEDO, OHIO 43614; PHONE 419-297-2943; EMAIL mdlorton@umich.edu

25 April 2019

Dear Commissioners:

Pursuant to 10 CFR 2.802, Algignis, Inc. (hereinafter "Petitioner" or "Algignis") respectfully petitions the United States Nuclear Regulatory Commission (hereinafter "NRC") to issues rules and/or regulations authorized by the Atomic Energy Act of 1954, as amended, as follows:

1) Rules and/or regulations authorizing issuance, amendment, or modification of an operating license for a nuclear power plant such that waste heat co-generated from said nuclear power plant can be recovered and utilized for
    a. Thermal storage;
    b. Electricity generation;
    c. Horticulture, agriculture, aquaculture, cultivation of algae/organisms;
    d. Industrial, commercial, manufacturing, processing;
    e. Biomaterials, bioplastics, biofuel;
    f. Fermentation, chemical/biological processing;
    g. Heating/cooling;
    h. Desalination, water treatment, water purification;
    i. Feed, fertilizer, biomass;
    j. Composting, biodegradation; or
    k. Any other use to which the waste heat may be put.
2) **<u>Amendments of each of the Design Certification Rules in Appendices A-N of 10 CFR Part 52 that would standardize the methods by which waste heat could be safely recovered and utilized from each of the respective types of nuclear reactors in the U.S.</u>**
3) Rules and/or regulations that would clearly and unequivocally authorize site- or plant-specific orders for the construction, operation, and maintenance of heat exchangers or other methods of recovering and utilizing waste heat.
4) Any other rules and/or regulations the NRC may find reasonable and necessary to implement the objective of productively and safely recovering and utilizing waste heat from the Nation's nuclear power plants.

If you or your staff has any questions or concerns, please do not hesitate to contact us.

Respectfully submitted,
/s/ Michael D. Lorton for Algignis, Inc.

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Executive Summary

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3. Discussion of Petitioner's proposed solutions and citation of publicly-available technical, scientific, and other data supporting the proposed solutions, rules, and/or regulations.
4. The express statutory and legal authority on which the NRC may adopt and issue the proposed rules and/or regulations.
5. Rulemaking by the NRC is the most favorable approach to solve the problems herein identified.

1. Identifying Information for Petitioner, Algignis, Inc.

Petitioner:

- Algignis, Inc. (pronounced as if the concatenation of two Latin words "Algae-Ignis")
- 2201 Townley Road, Toledo, Ohio 43614
- An Ohio C-Corporation
- Register agent: Christy A. Lorton, M.D., 5114 Bostwick Road, Perrysburg, Ohio 43551
- Individual signing the §2.802 Petition for Rulemaking before the U.S. Nuclear Regulatory Commission: Michael D. Lorton, M.D., J.D., MBA (Managing Shareholder), 2201 Townley Road, Toledo, Ohio 43614; Phone: 419-297-2943; Email: mdlorton@umich.edu.
- Algignis, Inc. has filed applications for Preliminary Permits for licenses to be issued by the Federal Energy Regulatory Commission (FERC) that would allow Algignis, in conjunction with the FERC and NRC licensees/owners of the nation's nuclear power plants to construct, operate, and maintain Algae Cultivation, Processing, and **Energy Co-Generation Facilities** co-located with said nuclear power plants. The proposed Algae Cultivation Facilities would 1) use the waste heat and water pumping capacity of the nuclear power plants to, 2) grow genetically-engineered algae or other micro-organisms at economically viable commercial scale to: 3) significantly reduce toxic algae blooms by substantially cleaning the adjacent bodies of water of their excess carbon, nitrogen, and phosphorous; produce biodegradable bioplastics that would substantially reduce petroleum-based plastic pollution; and thereby preserve many of the nation's zero-carbon nuclear power plants that are soon to be closed and decommissioned.
- Algignis estimates that minimum efficient scale will limit the number of Algae Cultivation Facilities producing bioplastics/biomaterials to 3-5 in the entire United States. Many of the other nuclear power plants may have to monetize the waste heat recovered from their reactors in other ways similar to those listed in the Executive Summary other than by algae cultivation.

2. Specific Problems Petitioner Contends Would be Addressed by NRC Rulemaking

Un-utilized Waste Heat from Nuclear Power Plants

Approximately 65% of the heat co-generated by nuclear power plants in the United States is lost to the environment. Almost none of the waste heat is put to any productive use. Only the Diablo Canyon Nuclear Power Station in California has utilized waste heat, and that was to drive a desalinization process. The Russians have used waste heat from nuclear power plants for heating of local houses and factories. Two nuclear power plants, one in India and one in Pakistan, have been retro-fitted to use waste heat to drive co-located desalinization plants.

Nuclear energy is a safe, reliable, concentrated, low-carbon source of electricity that is absolutely critical to forestalling accelerating global climate change, yet many of the U.S. nuclear power plants are under severe economic pressure and on the verge of closing. Nuclear co-generated heat is a valuable asset that is currently being wasted, but could be utilized to produce valuable products and services that would make nuclear power economically viable.

Global Climate Change and Nuclear Power

There is a strong and growing scientific consensus that mankind's production of CO2 and other greenhouse gases (GHG) are rapidly accelerating global warming and the deleterious consequences that result therefrom. Plentiful, reliable electricity is essential for the both continued functioning of developed societies as well as improving the quality of life in developing societies. A significant portion of the rapidly increasing CO2 level is a direct result of burning fossil fuels for energy. The combustion of fossil fuels also causes particulate, nitrogen oxides, and sulphur oxides pollution that directly contributes to a large number of excess deaths. Nuclear power provides a low-carbon (full lifecycle analysis), concentrated, reliable source of electrical power.

Renewable energy sources, solar and wind power, suffer from the problems of dilution and intermittency. In order for solar and wind to supply any significant percentage of the world's energy, we will have to devote massive amounts of land to solar panels and/or wind turbines (the dilution problem), and we solve the storage (intermittency) problem. In spite of much hyperbole, there are currently no economically viable energy storage solutions for the intermittency problem. Germany, more than any other nation, committed itself to renewable solar and wind energy. The Germans decommissioned all of their nuclear power plants and relied largely on coal-fired power plants to provide power when the solar and wind sources are inadequate for the load. Now the Germans produce more CO2 than they did before they closed their nuclear power plants and went "green". The cost of electricity in Germany is much higher than in France, which has continued to rely on nuclear power.

There are multiple secondary problems that directly or indirectly result from Global Climate Change and Nuclear Power issues:

a) Humans burning fossil fuels are contributing significantly to increased CO2 and other greenhouse gases. Those GHG are, in turn, rapidly accelerating global climate change, volatility, and warming.
b) Global warming in tandem with eutrophication of our rivers, lakes, and oceans have resulted in pernicious toxic algae blooms.
c) Petroleum-based plastics are massively polluting our landfills, rivers, lakes, and oceans. Microplastic particles are in the food chain and cause significant deleterious health effects
d) For political and economic reasons, fossil fuels are largely not subject to carbon taxes that would price in their emissions externalities.
e) For political and economic reasons, the toxic and carcinogenic chemicals used in hydraulic fracturing ("fracking") are largely unrestricted even when used in relatively

close proximity to drinking water sources. Production of natural gas releases significant CO2 and methane above and beyond the CO2 and oxides release by burning natural gas. Natural gas produced by fracking is currently very inexpensive. Natural gas that does not carry the costs of those hazardous fracking chemicals, CO2, methane, and oxides has made nuclear power economically non-competitive.

f) Both the New York Times (NYT) and the Wall Street Journal (WSJ) have documented that the oil and gas fracking industry lost approximate $50 billion USD from 2012-17 and is still unprofitable in 2018-19. Natural gas is priced below the cost of production. The NYT and WSJ have also documented that the fracking industry has significantly over-estimated its reserves and underestimated it futures costs of production. In 5-10 years, when natural gas supplies prove to be much less than projected and recovery costs prove much more than projected, the cost of electricity generated by natural gas will rise rapidly. The costs and time-lag needed to build nuclear power plants are immense. That means nuclear power generation has a very long and costly barrier to entry, and nuclear power supply will not be called quickly back into the market, if at all, when gas prices skyrocket. Preserving current nuclear power plants preserves a readily available power supply when natural gas prices inevitably rise.

g) While there is no political will to impose a carbon tax, such a tax would impose a legitimate leveling cost on the CO2 released by burning natural gas. If they were made to pay for the CO2 and pollution externalities the carbon-emitters now impose on the rest of society, nuclear power would no longer be a cost disadvantage. In the absence of a correction of the CO2/methane/oxides externalities market failure, allowing nuclear power plants to recover and monetize their waste heat would make them more likely to remain economically viable.

h) The premature retirement and decommissioning of nuclear power plants does not leave sufficient time for nuclear decommissioning trust funds (NDT) to build up to the level needed to adequately decommission those facilities. Some owners/operators of the nuclear power plants are trying to dump the NDT short-fall and environmental cleanup liabilities on the taxpayers. The FirstEnergy Solutions bankruptcy case in the Northern District of Ohio is illustrative. FirstEnergy, the parent holding company, has unsuccessfully attempted to move all of the decommissioning and environmental liabilities into its bankrupt nuclear generation subsidiaries, and to legally and financially isolate those subsidiaries by a business separation agreement from it profitable transmission and distribution subsidiaries. Had the Department of Justice, USEPA, Ohio EPA, the Ohio Attorney General, and several citizens' groups not objected, and had the bankruptcy judge signed off on the deal, FirstEnergy would have been able to use the bankruptcy order and injunction to deny any future liability. When, in a few years, the demonstrably deficient NDTs proved insufficient, the now-separate generation subsidiaries would have been back in bankruptcy—only then in Chapter 7 liquidation. The decommissioning and environmental cleanup burdens then would have rested with taxpayers under the Comprehensive Environmental Responsibility Compensation, and Liability Act (CERCLA). If the parent holding company must cover any future decommissioning and/or environmental cleanup costs, those costs will have to be transferred to the ratepayers by tariff or the transmission and distribution subsidiaries

will go bankrupt. The total estimated site-specific decommissioning and environmental deficiencies for the FirstEnergy nuclear power plants are $1-2 billion US. Most other nuclear power plants are estimated to have deficiencies as well. Preserving the current nuclear power plants would provide time enough to bring the NDTs up to sufficient levels.

3. Discussion of Petitioner's Proposed Solutions

Waste Heat Recovery from Nuclear Power Plants

We at Algignis, Inc. have filed applications for Preliminary Permits for licenses for Algae Cultivation, Processing, and **Energy (heat) Co-generation Facilities** for all of the nuclear power plants in the United States with the Federal Energy Regulatory Commission (FERC). We have several aims, including, but not limited to: 1) using waste heat from nuclear and other power plants, 2) to grow genetically engineered algae/other organisms at economically viable commercial scale, 3) to substantially clean eutrophic bodies of water to reduce toxic algae blooms, and 4) to substantially reduce petroleum-based plastic pollution by producing bioplastics at economically viable commercial scale. We estimate that minimum efficient scale will allow for only 3-5 such algae bioplastics facilities in the United States. The other nuclear power plants would use their recovered waste heat to produce valuable products and/or services.

To the extent that such alternative business plans would be economically viable (i.e. profitable), we would use the waste heat from other U.S. nuclear and other power plants to produce alternative valuable products or services, such as 1) additional energy generation; 2) production of other biomaterials/bioproducts; 3) substantially cleaning adjacent bodies of water of carbon, nitrogen, phosphorous, and other contaminants, 4) substantially cleaning wastewater; 5) desalination and water treatment; 6) local heating of homes and factories; 7) other aquaculture or horticulture; and 8) any other businesses that could profitably recover waste heat.

Lots and lots of people have written and spoken about these objectives in great detail and at great length. We at Algignis, Inc. are the first to step up and actually attempt to execute on these technologies and objectives. Achieving our objectives will be incredibly complex and incredibly daunting, but someone has to do it. Those of us who depend on Lake Erie for our water and so much more simply cannot wait for the glacially slow political, judicial, and regulatory entities to solve the toxic algae blooms, plastics pollution, and climate change problems. We have to step up and solve our own problems.

Biotechnology, bioplastics/biomaterials, and nuclear energy are extremely complex and expensive endeavors. Algignis will be able to utilize economies of scope and scale to move down the learning/cost curves and to implement best practices in its nuclear waste heat recovery projects.

We understand that we will need allies, and this is where the Nuclear Regulatory Commission (NRC) comes in. We will need the regulatory guidance, cooperation, and permission of the NRC to place heat exchangers and other infrastructure near nuclear power plants in order to recover

and use waste heat for our objectives. The NRC has an excellent pathway in 10 CFR Part 52 to approve Standard Design Certifications (SDC) for different types of nuclear reactors. Those SDCs provide greater economic and regulatory certainty for those desiring to construct, operate, and maintain new nuclear power plants. The NRC could use a similar process to make rules that pre-certify new SDCs for Nuclear Waste Heat Recovery Systems (NWHRS). We propose that NRC use its rule-making power under the Atomic Energy Act (AEA) to establish Standard Design Certifications for waste heat recovery processes for each of the current types of nuclear reactors in operation in the United States. That will help us and our owner/operator partners immensely by providing relative economic and regulatory certainty. If a certain type of nuclear reactor design is currently authorized under SDC Schedule A, then the corresponding SDC for the waste recovery system for that type of reactor would be authorized under SDC Schedule AA; for SDC Schedule B, SDC Schedule BB, and so on (or any similar designation scheme NRC chooses).

Technical and Operational Appendix

To this Petition for Rulemaking, we will attach a Technical and Operational appendix with suggested formats by which engineering information would be submitted to NRC for consideration in making new Standard Design Certification rules for Nuclear Waste Heat Recovery Systems. We have provided annotation and references with this appendix. Of course, we welcome any comments and/or suggestions by the NCR staff on these issues.

4. The Express Statutory and Legal Authority on Which the NRC May Adopt and Issue the Proposed Rules and/or Regulations

Sections 182, 185, and 189 (42 U.S.C. §§ 2232, 2235, and 2239) of the Atomic Energy Act provide express authority for NRC to make rules for the safe, efficient construction, operation, and maintenance of nuclear power plants and their appurtenant infrastructure. The NRC has exercised that authority repeatedly when it made rules pursuant to 10 CFR Part 52 to establish Standard Design Certifications for nuclear reactors. Exactly the same process is authorized for establishing Standard Design Certifications for Nuclear Waste Heat Recovery Systems.

5. Rulemaking by the NRC is the Most Favorable Approach to Solve the Problems Herein Identified

Rulemaking is exactly how the NRC has completed the 10 CFR Part 52 amendments/additions process for the Standard Design Certifications for nuclear reactors. That process has worked well to provide regulatory and financial security for those contemplating constructing new nuclear power plants. In the same way, Standard Design Certifications rules for Nuclear Waste Heat Recovery Systems would provide a greater degree of regulatory and financial certainty for those seeking to use nuclear waste heat recovery to provide valuable products and/or services and to make currently operational nuclear power plants economically viable.

Respectfully submitted,

/s/ Michael D. Lorton for Algignis, Inc.
mdlorton@umich.edu