SMR Patent Landscape

Insight and Analysis Spring 2021

By

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Table of Contents

I.	Introduction	2
II.	Methodology	3
III.	Timeline	7
IV.	Location	.11
V.	Subject Matter	.14
VI.	Ownership	.18
VII.	Spotlight For Insight: NuScale Power, LLC	.22
VIII.	Spotlight For Insight: TerraPower, LLC	.29
IX.	Spotlight For Insight: Chinese Patent Office Filers	.37
X.	Appendix: SMR "Key Player" IP Profile Dossiers	.42

I. Introduction

In late 2020, the United States Nuclear Regulatory Commission issued its first-ever design approval for small modular reactors (SMRs) to NuScale Power in Portland, Oregon after an upand-down 3 year review process.¹ This marks a landmark achievement and harbinger for looming expansion of SMR in the US energy market. With their stated goal of bringing SMR to market in the 2020's and 2030's, the U.S. Department of Energy (DOE) believes SMR advancements will be key towards achieving "U.S. energy independence, energy dominance, and electricity grid resilience, and assuring that there is a future supply of clean, reliable baseload power."

The DOE has placed a growing priority on this area of innovation, and has committed to "accelerating U.S. advanced nuclear technology via private-public partnerships with our industry partners and national laboratories".² The approval comes amidst a massive financial push by the United States to invest in the technology's development. For example, in late 2020, the DOE announced that it has put another \$26.9 million towards advancing nuclear technology development, and specifically towards advancing SMR safety and efficiency to bring it to market.

In 2018, the International Atomic Energy Agency (IAEA) identified approximately 50 SMR concepts that were at some stage of development, though only a small number of these concepts were actually under construction at that time, with the remainder being at the design stage. Accordingly, intellectual property and control in this area of innovation will be crucial in developing and maintaining market share for a variety of industries, as SMRs move from the design and licensing stages to active construction and operation. This report will investigate the current state of this technology and how it may evolve moving forward.

¹ https://www.csis.org/analysis/first-ever-us-approval-small-modular-reactor-design-and-its-implications

² https://www.energy.gov/ne/articles/us-department-energy-announces-269-million-advanced-nuclear-technology

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SMR Patent Landscape: Insight & Analysis

II. Methodology

To begin our investigation on the state of intellectual property of the field, we begin with what SMR actually is. A Small Modular Reactor is defined as a nuclear reactor with a power output between 10 megawatts electric (MWe) and 300 MWe. Designs with outputs smaller than 10 MWe are referred to as micro modular reactors (MMRs), though many of the same technical improvements may be applicable to each. SMR concepts are, presently, most often based on Light Water Reactor (LWR) technology; LWR technology employs a thermal-neutron reactor that uses normal water (as opposed to heavy water) as both coolant and neutron moderator, and makes use of solid fissile elements as fuel. SMRs in development are in many cases "Generation IV" reactors, which make use of alternative coolants (i.e. liquid metal, gas or molten salts) and advanced fuels.

In reviewing the state of technology, the filing activity relating to the industry provides crucial insight into what that landscape looks like. Key areas to look at include how many applications are being filed, who is filing them, where are they being filed, what is the subject matter, and more, along with the specific trends in each area and where they may be heading. Accordingly, for this review we analyzed the pool with the following subjects in mind:

- 1. Timeline
- 2. Location
- 3. Subject Matter
- 4. Key Players

To fully understand the role each plays in filing decisions, there are several things to note about each of these subjects corresponding to the following sections of this report.

A. Timeline

For understanding the IP rights in the context of an industry's timeline, there are two specific aspects of the patent process to take note of.

Th first is the relationship between granted IP rights and filing. An issued patent generally provides IP rights for 20 years from the filing date before expiring. This means future planning is crucial in developing a portfolio based around a strategic IP plan. From the date an application is filed, the review and hopeful issue of the patent is often multiple years down the line and the return on investment (ROI) may not come for multiple years. Just like research and development costs, a portfolio's true value is often not apparent immediately and may pay off up to a decade or more after filing. This means that monitoring and analyzing the filing trends of the current landscape can provide insight into where the overall industry will likely be in the future, but not a definitive answer.

The second key aspect to understand is the publication process. Patent applications will, in almost all cases, be published by the host country for public viewing regardless of whether the patent application issues as a patent or not. This takes place after a short period of varying length (which depends on the country, but is usually 18 months) and the type of application. In the United States, pending applications publish after a period of 18 months from the earliest priority date (meaning, for example, that "continuation applications" with an earlier effective priority date will publish earlier) unless the applicant requests nonpublication, which has the effect of restricting the applicant's foreign filing rights. The general 18-month delay is important to note because in constantly developing fields, this means there may have been changes to strategies and innovation that will not become apparent until the new applications start being published at a later time.

However, the publicly available information can still provide general directions and insight that can be very fruitful in decision making and strategy with regards to your IP Plan.

B. Location

IP rights are dependent on each country's individual laws and regulations. The duration of control, eligible subject matter, and rights afforded to each application or registration are all determined by the governing authority of the physical area. This means that the location where applications are filed is heavily indicative of where the filer believes those rights will be valuable moving forward. Accordingly, by analyzing the location of applications around the globe, we can learn valuable insights into where the filer anticipates getting value from their IP rights moving forward. Even if a filer does not wish to have a physical presence in an area, a patent may give them some level of control over the IP space in that area, which may hold significant value to them based on what they believe other competitors will be doing or trying to do and how that may play out on the industry-wide landscape. (For example, it may impede a competitor directly, may impede a competitor's suppliers, or may help promote cross-licensing.)

C. Subject Matter

In completing this report, a pool of patent applications and grants was identified as "SMRrelated". The patents that were SMR related were based on the following search terms: "small modular reactor", "fuel assembly" "fuel vessel", "pressurized water", "molten water", "boiling water", "sodium-cooled" or "lead-cooled". This produced a broad total pool of 23,107 patent applications or grants that are SMR-related before addressing more pools of analysis within it throughout our analysis. There may be additional patents that *could* have relevance, but this represents the best balance of including as much as possible of the most relevant material for the industry.

Due to the delayed return on investment of a portfolio, it is important to ensure that any IP filings take into account what aspects of technology are most crucial for your success moving forward. (Since patents have a 20-year term, often patents concern technology that is expected to still be in use in 10+ years.) This is compounded by the investment that is required by research and developing these areas to begin with. Accordingly, by looking to see what aspects within the industry are being most heavily invested in and for trends in the success of each, we can learn how important different areas of subject matter may be moving forward.

To learn this, it is useful to have a streamlined quick hand for categories of subject matter. The "Cooperative Patent Classification" is based on the subject matter claimed and was developed by the USPTO and EPO. Upon receiving an application, patent offices will categorize the application for review as they assign examiners most familiar with that area of technology, many using these CPC Codes. This system includes a broad Section, a Class, a Subclass, and a Main Group getting more specific in that order. These classifications can be useful in quickly comparing the subject matter between different filings and portfolios and can show what things are in development or concern for the rights holder, and how much they value it moving forward.

D. Ownership

IP rights are based on the ownership, not the inventorship, of the rights to the underlying technology. Accordingly, by looking to see who is filing applications we can tell who is making the investment into prosecuting that application for a hopeful ROI, and by looking to who owns a granted patent, we can tell who controls those rights moving forward. This is vital information to combine with the other factors to identify the key players moving forward in different physical and technological areas.

SMR Patent Landscape: Insight & Analysis

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Spring 2021

7

III. Timeline

Within a timeline, the key aspects to consider are what *has* happened and what *will* happen. To gain insight on each, there are different relevant pools of SMR-related IP. For what *has* happened, the most useful indicator are the currently active granted patents. While their expiration dates can tells us some things about how things will play out, the much more useful pool for what will happen in the next decade are the currently active patent applications.

For our active grants patents, we can learn the most from the timeline of their priority dates. Patent terms begin based on those priority dates, so by looking to when the granted pool claims priority, we can tell how generally crowded the IP landscape was over time. Here is how the 7,343 granted SMR-related patents claim priority over time in each of the top 5 filing destinations.



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This shows that overall the total number of active patents at any time has been fairly consistent over the past fifty years, and tells us what filings have been deemed "new" in the technology. This shows us how the "new" technological advancements are progressing over time. The first grant appears nearly a century ago, with some major strides being made in the 1950's and fairly consistently onward as more countries got involved. We can also see the relative location where advancements have been believed to have been most valuable by looking at which country was the source of priority. For instance, very early in the SMR timeline, it appeared that France was on the forefront of this area of technology, or that France was seen as the most fertile ground for filing, since the largest share of advancement in IP rights was being claimed in France. (While France has the highest proportion of nuclear energy generation in the world – upwards of 70% of their production is nuclear – the "Messmer Plan" that was famous for creating this did not happen until the 1970s oil crisis, while the large spike in IP filings came well before this.) However, they have not shown such a dominant position in 50 years, likely because their nuclear power industry is already well-developed, and the lifetime of existing reactors can be extended. Conversely, China's presence on the timeline didn't begin until the 1980's, but grew up until a major leap beginning in 2005. In the middle, we find Japan, where granted rights began growing in the 1970's before achieving a steady position atop the chart for multiple decades before a current decline. While there are few active rights in France to navigate as a result (and there may be opportunities here if France does elect to start phasing out existing reactors earlier than planned in favor of SMR technology), the rights in China are likely to be significant with respect to what companies can do over the next two decades, with Japan's congestion relevant but decreasing over the next 5-10 years as the patent terms end.

However, as noted, the granted patents only paint part of the picture. A significant aspect of portfolio development is whether you choose to file a patent application at all. This tells us what you think will be most important about what you plan to do. Therefore, by looking at a timeline of applications filed that are SMR-related, we can see how the industry has been valued and projected. This grouping included 9,466 SMR-related applications.



Because only some applications end up with a grant, these numbers are all comparably higher than those in the previous graph. Japan's timeline for filing explains the decline in granted patents. The number of applications filed in Japan over the last decade has been in decline since the turn of the century with a dramatic decrease in the last decade. This correlates to the investment being made to developing nuclear power in Japan. While there was significant interest prior to 2000, the valuation of these investments has dropped since, with a notable drop in filings following the 2011 Fukushima Daiichi Nuclear Power Plant Disaster as public perception there took a hit.

Conversely, we can see a significant increase in interest for most other countries beginning in 2000, especially in China. This makes sense of patent's jump in active grants, explained by

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Spring

2021

greater interest and value of the investment. Overall, in a global sense, we can expect to see more SMR-related grants to navigate around in the industry over the next 20 years, especially in the United States, China, and the EU, as well as Japan, who will merely have a less comparatively crowded landscape than they have had over the past few decades or may regain interest as proximity to the disaster fades over time and investment increases again. This will make these areas especially notable to watch moving forward in our other analyses.

Spring 2021

IV. Location

As noted, only a few dozen SMR designs have been made to date. The designs attempted have had varying success and are at different stages of development across the globe. Russia is currently dominating the physical SMR landscape, and all three operational SMR designs are located in that country, with an additional reactor under construction. (The Russian EGP-6 reactor, located in far northeastern Russia in Bilibino, Chukotka Autonomous Okrug, is an older design from the 1970s and is awaiting decommissioning; Russia has two more reactors, the KLT-40S and RITM-200 models, which are each located aboard nuclear-powered icebreakers. The remaining reactor under construction, the BREST-300-OD, is a demonstration unit located near the city of Tomsk.)

No other country has an operational SMR site, though Argentina has one under construction as well. (Their CAREM-25 reactor is undergoing construction, though this has recently stalled, with the contractor citing late payment from the government, unanticipated design changes and late delivery of technical documentation.) As the approval and construction process for these reactors can often take a long time, this number is unlikely to change dramatically in the immediate future; SMR sites currently in development appear to be limited to one in Russia, one in South Korea, and two in the United States.

Taking the pool of SMR related patents and charting them by jurisdiction, we can see what the current and future landscape may look like.

First, we'll look to where the currently active granted patents are located to see what the most highly contested areas are now. In total there are 3,556 active SMR-related patents.



The vast majority of these active patent rights are in China, with Japan, the United States, and the EU also well represented. However, this only tells us where the *current* rights are held. As explained in the methodology section, by shifting to where there are active applications, we can gain insight into where rights are being sought, and therefore, where the industry may see future value moving forward. While these applications will not all issue and produce future IP rights, it is likely that a significant portion of them will. This makes these active applications a very useful indicator for the future distribution of rights, which contains 1,379 SMR-related applications. To also gain some insight into the proportion of rights between each country, a heatmap of the active filing locations is especially helpful.

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Unsurprisingly, we can see the most applications have been filed in China over the last five years, reflecting their position of heavily investing in SMR-related technology for the past two decades. With over 300 SMR-related applications filed in China in 2016 alone, this will represent a difficult and hotly contested region to implement over the next two decades.

We can also see that while we saw a decline in Japan, this is still one of the places with the most active SMR-related filing activity in the world, supporting the proposition that while Japan has declined in relative congestion, it will still be among the most congested in the future. Additionally, notable is the presence of the United States, where there may be a significant increase of grants from their pending applications. This makes sense given the financial backing of the U.S. government and the relatively recent priority it has placed on developing this field. We will likely see the landscape in the U.S. becoming more hotly contested on the IP front moving forward for the United States as the investments result in more applications and ultimately more grants for SMR-related rights.

Spring 2021

Subject Matter V.

With a sense of the general timelines and regions of interest, we can gain even further insight to how the industry is developing by looking at the types of technology with the industry. This can tell us what technology within the industry is being improved in the IP. As explained above in the methodology section, CDC codes can be especially helpful for identifying subject matter within a given pool.

Again, we can begin by looking at the subject matter for the 3,556 active SMR-related grants.



Nearly 1/3 of all active SMR-related patents are represented in a single category - Y02 E30/00: Energy Generation of Nuclear Origin - and 10 of the top 21 groupings are in the broader G21C category for Nuclear Reactors. This is in line with our expectations, but is helpful confirmation that our pool has been properly defined to cover the intended material. (In growing

industries, this can sometimes be difficult, since new technology will often not fit into old categories or make use of old terminology.)

However, these categories altogether only account for 78.2% of our pool. By looking at the remaining 21.8%, we can find out what SMR-related advancements have been made outside of those immediately expected areas. These subgroups may contain valuable insight on some of the more tangential aspects of the industry where advancements made in other industries may have produced IP rights that need to be navigated within the SMR industry. These advancements in technologies may be used heavily and relied upon due to an overlap between SMR and other industries in a particular category, but exist outside the expected primary classifications we would expect based on their focus. These advancements could have a significant role in shaping the eventual control and presence various players have in SMR moving forward. Accordingly, the types of results in this 21.8% of our pool will bear monitoring by the SMR industry for potential sources of further advancements in other industries which could also be applied to its related purpose in SMR or for potential research and development partners in industries where those interests align.

Some of the notable categories for these purposes include C02 F1: *Treatment of Water*, *Waste Water, or Sewage*, B01J *Physical Or Chemical Processes, e.g Catalysis Or Colloid Chemistry; Their Relevant Apparatus*, C22C *Alloys*, and F04 F05/00 *Jet Pumps*. Patents in these categories moving forward could cover the production of new alloys for application and benefit in SMR, new efficiencies and abilities for pumping water within SMR reactors, or the ongoing water treatment considerations at plants.

Just as before, the active grants do not tell the entire story. By comparing the active grants with the applications filed in the past five years, we can see if there are any notable investment

trends for the filing subject matter that may inform investment strategies to further strengthen an IP plan. We can now compare our Active Grant Pool of 3,556 with the last 5-years' 804 Filed Applications SMR-Related pool.

We can quickly compare the relative compositions of classifications using a Circle-Packing diagram where the broadest categories are shown in the biggest circle, with smaller circles within it to show the subcategories. The Grant Pool is on the left, while the Application Pool is on the right.



Above: Active Granted Patents (Left) v. Active Applications Filed Last 5-years (Right)

The Active Grant and Filed Application diagrams look fairly similar, with G for *Physics* the largest circle dominated by the G21 for *Nucleonics* sub-circle, and surrounded by smaller but significant circles representing F *Mechanical Engineering Lighting Heating Weapons Blasting*, B *Performing Operations Transporting*, C *Chemistry*, and Y *General Tagging of New Technology Developments; General Tagging of Cross-Sectional Technologies Spanning Over Several Sections of the IPC; Technical Subjects Covered by Former USPC Cross-Reference Art Collections [XRACs] and Digests*, among other less significant categories.

However, we also see that Circles B and C are have *grown*. These subgroups represent specific aspects of SMR-related applications with implications that may be outside the SMR industry alone. Because some filings are labeled with multiple classifications, we can look for filings categorized in both G21 and either B and C to see what sorts of applications may be of growing relevance to the SMR industry moving forward. A selection of some of the patents with the highest *Patent Strength* can give us some example of the especially strong examples in these growing areas.

One such strong application in both B and G21 is WO2016183388 A1 for *Systems and methods for nuclear reactor vessel segmenting*. From the specification, we learn that it pertains to the technical field of material "segmenting" and particularly the field of hazardous material segmenting and/or segmenting in hazardous environments, such as nuclear power plant component and equipment dismantling, or any application where metallic components are to be segmented for removal and disposal. That is, this technology is connected to the decommissioning process of reactors. As the industry grows and there are more plants (or as countries like France retire their existing reactors in favor of SMRs) the need for such safe decommission will grow and the related IP holdings will grow in value.

As a whole, we have learned that the subject matter of the active patents are the same ones as the recent filings predict will be most significant moving forward over the next two decades. The industry has not yet matured and the advancements do not appear to have "capped" yet, forcing the industry to more aggressively incorporate technology from other fields and reshaping the relative importance of these other aspects. New fields may -- and likely will -- play a role moving forward, but the overall makeup will likely at least approximate that of the currently active subject matter. SMR Patent Landscape: Insight & Analysis

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VI. Ownership

Ownership in SMR projects ranges significantly, as commercial endeavors, government organizations, and special interest groups all have vested interests in the energy sector and SMR representing a key area for each. In sum, of the active grants and applications combined there are 1,057 different entities with SMR-Related holdings, each with significantly different interests and practical purposes. In order to identify the ones who will play the biggest roles moving forward, we use the following lenses.

The ownership entities with SMR IP could all play a role in the market in the coming years, but to see what kind of threat they may pose with their portfolio, we look to this representation factoring in the resources and tendencies of the most notable holders. First, we'll limit the holdings to those SMR-Related grants and applications which are currently active to see where the most relevant IP players are right now.



This Market Presence bubble chart identifies the effective intellectual property "threat" or "presence" posed by each entity. In the chart, Resources (combining revenue, litigation, and locations, essentially characterizing an ability and willingness to engage in sustained litigation) is graphed against Vision (combining Patents, Classifications, and Citations, essentially characterizing patent activity and the apparent level of overlap of their technologies with others), with the plot size based on the size of their portfolio.

Some of the other notably large portfolios occupy space along the very bottom of the chart in the right bottom quadrant. These include Hualong Pressurized Water Reactor Technology Corporation, Ltd. with a portfolio of 83 in Dark Green, Nuclear Power Institute of China with 148 in White, and Orano SA with 312 in Blue. These represent entities whose holdings cover a wide swath of the landscape, but whose revenue, litigation history, and number of locations may limit their overall effect on the industry as a whole, keeping them low on the chart.

However, those with the most "Market Presence" above are located in the top right of the graph with the size of the circle showing the relative size of the portfolio anchoring that presence. The top quadrant represents the most relevant and some of the largest Market Bubbles. These three include Toshiba Corporation with 632 in Pink, General Electric with 269 in Yellow, and Hitachi, Ltd. with 305 in Black. These three will be likely to be key players moving forward and the likeliest to have the greatest effects on the future landscape of the global SMR market.

By adjusting our pool to those filed in the past 5 years, we get a pool of 1,654 grants and applications which can help us see where things are likely heading.

Spring 2021



While Toshiba (Pink) remains affixed in its dominant position on the top right with a large role to play, we see both Hitachi (Black) and GE (Yellow) moving right to join Toshiba and the GE-Hitachi Nuclear partnership jockeys for position in the intensifying Nuclear Energy sector. Further, we also see Hualong Pressurized Water Reactor Technology (Dark Green) and Nuclear Power Institute of China (White) shift dramatically to the right. This tells us they were likely a major contributor in the rise of SMR-Related filings in China and will play a growing role as China's SMR industry advances in the coming years.

Finally, some notable new entities make appearances on this chart, who may represent newer players in the industry who are filing now to build up for a push into the industry in the coming years. These entities are likely focused on research and development now, but may be building their portfolio for additional investment in the market moving forward. One such candidate is TerraPower, LLC, who appear in the bottom left in this chart but were not among the most influential when looking at the previous pool of all active holdings.

Next, by cross referencing a pool of 1290 SMR-Related filers in the past 10 years with the entities with already completed SMR designs, we can identify 10 of the specific key players of the current industry to assess their potential for lasting position as these current investments come to bear in the next two decades.

Key Players		
Toshiba Corporation		
Hitachi Inc.		
General Electric Corporation		
Orano SA (Areva SA)		
TerraPower, LLC		
NuScale Power LLC (Fluor Corporation)		
Babcock & Wilcox		
KEPCO Nuclear Fuel Co., Ltd.		
Rolls-Royce Group plc		
Holtec International		

These entities represent those most likely to be implementing new SMR technologies moving forward and may shape the industry moving forward. For example, we see NuScale Power LLC (with heavy investor Fluor Corporation) here. This makes sense because they just obtained approval for an SMR site in the United States this past fall. This will be a cutting-edge facility if it becomes operational in the coming years. Accordingly, NuScale's specific filing areas may contain key indicators about where the industry's most competitive IP battles will be fought as NuScale proceeds from licensing stage to implement their design in the United States and gain practical knowledge to bolster their position further.

In the Appendix we provide an IP Dossier for each of these 10 Key Players, along with more detailed Spotlights For Insight sections on NuScale Power, LLC and TerraPower, LLC.

VII. Spotlight For Insight: NuScale Power, LLC

In order to get a better sense of what some key players may be doing specifically, we need a deeper dive on aspects of their portfolio alone. This spotlight highlights some key aspects of what they have done and what they may be planning as their role in the coming years begins to solidify.

A. Selection of NuScale Power, LLC

For reference, NuScale Power, LLC is a small private company located in Oregon that is focused on SMR technology, which was founded in order to commercialize research conducted by the Department of Energy early in the 2000s.

In developing industries like this one, identifying "up-and-comers" and analyzing their intellectual property investments with greater detail can show emerging trends to inform investments. Particularly smaller and more focused companies are especially useful for this, since the technologies that each is developing are more closely tied to SMR technology. Larger companies like GE-Hitachi Nuclear Energy operate much larger reactors, and so their portfolios appear to have a much larger area of focus that may be related to many other things besides the SMR specific industry. A patent application on a technology related to a maintenance system for an existing nuclear reactor, for example, might include a token recitation that it could also be applied to SMR designs despite not being intended for them. Smaller entities tend to align their intellectual property investment more closely to the final product of development, both near and long term.

With NuScale's recently earned approval in the United States, it represents a notable player in a major SMR market moving forward. A closer analysis of the total portfolio filings of NuScale SMR Patent Landscape: Insight & Analysis

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Spring 2021

Power, LLC can provide insight into what they have done, what they are doing, and what they are planning moving forward.

B. NuScale's IP Timeline

Just as for the industry as a whole, looking at the overall filing timeline for NuScale can provide significant insight into their general strategies and operations with respect to their IP. Here are how their holdings line up over time highlighting key aspects of their grants, applications, and interests.



First, we can see that this timeline is significantly shorter than the entire industry. This makes sense given their relatively recent founding and how large the barriers of entry are for SMR entry with high levels of regulation and future planning. After a strong initial push after founding, their volume was very low until a spike in 2014, before declining. This likely correlates to the advances and development of their current design recently approved in the United States, which was filed in 2017. After ensuring the key aspects that would be included in the filing, there was a

general decline. While this may not be as drastic as it initially looks since some later filed applications might no have been published yet from 2019, we can guess that many of these filings will tie fairly closely to this recently approved design based on this timeline. As NuScale can now move forward with that approval in hand, we may see another spike as those initial investments are more certain to bear fruit and they begin moving forward again with these plans.

We can also see from the strong correlations in the trends of the different lines that NuScale appears to be filing the same number of applications in various jurisdictions, this likely means they anticipate them holding value across a range of markets globally, and they may have broad aspirations for the coming years. To learn more about those aspirations, we look to another lens.

C. NuScale's IP Location

As addressed previously, IP rights are region specific, so looking at the distribution of a portfolio across the globe gives context for where that company is anticipating them holding value. This may not be tied to a physical site where they wish to practice the technology, but it does tie to where they anticipate the rights having value. Even without practicing the IP, rights in a country where a competitor is operating provide leverage. Having IP rights wherever you, competitors, or even potential competitors are located can be crucial.

Spring 2021

Patents per Source Jurisdiction (Incl Designated States)



This map correlates strongly to the one we saw for the industry as a whole, with filings across the United States, the EU, China, and Japan. The most significant investment is in the United States, unsurprising since it is an American company and their site is located within its borders and they will want to have protections in place for its technology. More surprising might be the level of investment in Europe and China, where they do not have a physical presence currently. This may indicate their interest in global leverage against competitors in the United States, but more likely it indicates they have plans to advance their presence in these Markets over the next decade.

Spring 2021

D. NuScale's IP Subject Matter

Too see what aspects of SMR technology NuScale's portfolio contains, we turn to the subject matter of the pool.

First, by viewing NuScale's portfolio by USP Class (the second level of categorization) in a Word Tree, we can see NuScale's most dominant areas of investment according to the USPTO Class category:



NuScale's patents are classified into the following technological areas. In sector 4 (Chemistry/Chemicals/Physics), most of their patents are classified into USP class 422 (Chemical Apparatus and Process Disinfecting, Deodorizing, Preserving, Or Sterilizing), which covers techniques for producing or refining particular materials, such as fuel production or refinement, as well as reactor apparatuses or aspects thereof. (For example, it appears that a significant number of filings in this area have to do with tube sheets for isolating particular regions of a reactor pressure vessel.) In sector 10 (energy), most of their patents are classified into USP class 376

(Induced Nuclear Reactions, Processes, Systems, and Elements), which largely covers the reactor methods of operation and elements related to the nuclear reactions in progress (such as heat removal or monitoring). Most of the portfolio is classified into these two areas, as would be expected. It appears that NuScale has also been exploring patent protection on some other features, largely related to material technologies; their patents within this classification appear to relate to a greater diversity of material technologies, with some relating to class 196, "Mineral Oils and Apparatus," and others related to class 148, "Metal Treatment."

While USP Class is important, it is tied to the prosecution and review aspect of the filing and may be excluding aspects of the holdings. Accordingly, by looking at the full text of he filings, we may find other areas of interest for their portfolio. To do this, we produced the below "PatentScape" text clustering chart, showing a rendition of the most common words and phrases in the holdings.



In this PatentScape and the next two, each cell represents 2 grants (blue) or application (yellow). The proximity of each cell to the center of the text cluster represents the degree to which the patents or patent applications in that cell deal with the text concept, with cells closer to the center of the cluster having more relevant references. This can help to show trends in patent filing; for example, if the cells closest to the center of the text cluster are mostly blue and the cells further away from the center of the text cluster are mostly yellow, this can indicate that the cluster represents a mature field, with a developed core having many granted patents, which inventors are trying to apply to new tasks and applications.

From this, we can see that while NuScale's overall portfolio is dominated by only two classes, the subject matter contained in each filing is extremely diverse when it comes to different aspects of the technology. The "reactor core" section's size is expected, but the "primary coolant", "plenum", and "heat transfer tube" ones may not be. The "primary coolant" section is significant in presence, meaning NuScale invested heavily in advancing the cooling process throughout the development of the current design making these patents key area to watch for similar designs moving forward.

One such strong granted patent in this group is United States Patent Number 8,731,130 B2 for *Passive emergency feedwater system*. From the specification, we learn that it pertains to a system for the cooling process of the core, with multiple coolants being used one coolant is circulated through the other to remove heat. Between this and the tubing identified previously, we can expect to see a major focus and role for tubing and coolant IP in SMR as the industry continues to evolve and require greater cooling mechanisms for safety and efficiency in implementation.

VIII. Spotlight For Insight: TerraPower, LLC

In order to get a better sense of what some key players may be doing specifically, we need a deeper dive on aspects of their portfolio alone. This spotlight highlights some key aspects of what they have done and what they may be planning as their role in the coming years begins to solidify.

A. Selection of TerraPower, LLC

For reference, TerraPower, LLC (TerraPower) is a spin-off of the IP holding company Intellectual Ventures, located in Washington State. It was founded in 2006 and is focused on SMR technology. TerraPower is specifically focused on developing traveling-wave reactors, a concept proposed in the 1950s that beneficially can confine fission to a boundary zone in the reactor core that slowly advances over time (the so-called "traveling wave"), allowing the reactor to breed its own fuel and allowing the reactor to utilize a sealed reactor vessel that does not need refueling. TerraPower's backing includes the DOE and Los Alamos National Laboratory, along with Bill Gates as a notable investor.

In developing industries like this one, identifying "up-and-comers" and analyzing their intellectual property investments with greater detail can show emerging trends to inform investments. Particularly smaller and more focused companies are especially useful for this, since the technologies that each is developing are more closely tied to SMR technology. Larger companies like GE-Hitachi Nuclear Energy operate much larger reactors, and so their portfolios appear to have a much larger area of focus that may be related to many other things besides the SMR specific industry. A patent application on a technology related to a maintenance system for an existing nuclear reactor, for example, might include a token recitation that it could also be

applied to SMR designs despite not being intended for them. Smaller entities tend to align their IP investments more closely to the final product of development, both near and long term.

With TerraPower's strong backing and focus on SMR, it has the potential to be a serious influencer in the direction of SMR technology and advancement. A closer analysis of the total portfolio filings of TerraPower, LLC can provide insight into what they have done, what they are doing, and what they are planning moving forward in the SMR landscape. This analysis covers a portfolio of 716 total items.

B. TerraPower's IP Timeline

Just as for the industry as a whole, looking at the overall filing timeline for NuScale can provide significant insight into their general strategies and operations with respect to their IP. Here are how their holdings line up over time highlighting key aspects of their grants, applications, and interests.



First, we can see that this timeline is significantly shorter than the entire industry. This makes sense given their relatively recent founding and how large the barriers of entry are for SMR entry with high levels of regulation and future planning. After a strong initial push after founding from 2008-2010, their volume slowed from 2011-2013. We then see some steady growth with significant peaks in 2015 and 2017. While a decrease after 2017 would be unsurprising given the cyclical nature of their timeline, the 18 months publishing delay we expect prevents us from seeing if TerraPower has completed a development phase or if they may still have more growth in filings coming in the immediate term.

B. TerraPower's IP Location

As addressed previously, IP rights are region specific, so looking at the distribution of a portfolio across the globe gives context for where that company is anticipating them holding value. This may not be tied to a physical site where they wish to practice the technology, but it does tie to where they anticipate the rights having value. Even without practicing the IP, rights in a country where a competitor is operating provide leverage. Having IP rights wherever you, competitors, or even potential competitors are located can be crucial.

Spring 2021

Patents per Source Jurisdiction (Incl Designated States)



This map correlates strongly to the one we saw for the industry as a whole, with filings across the United States, the EU, China, and Japan. By far the most filings are in the United States with three times as many as the next highest, but the holdings elsewhere in Europe and China are notable. This may indicate their interest in global leverage against competitors in the United States, but more likely it indicates they have plans to advance their presence in these markets over the next decade. In either case, TerraPower's reach will be focused in the United States, but may expand globally and balance that disparity in the coming years.

Spring 2021

C. TerraPower's IP Subject Matter

Too see what aspects of SMR technology TerraPower's portfolio contains, we turn to the subject matter of the pool.

First, by viewing TerraPower's portfolio by USP Class (the second level of categorization) in a Word Tree, we can see TerraPower's most dominant areas of investment according to the USPTO Class category:



TerraPower's patents are classified into the following technological areas. In sector 4 (Chemistry/Chemicals/Physics), most of their patents are classified into USP class 422 (Chemical Apparatus and Process Disinfecting, Deodorizing, Preserving, Or Sterilizing), which covers techniques for producing or refining particular materials, such as fuel production or refinement, as well as reactor apparatuses or aspects thereof. (For example, it appears that a significant number

of filings in this area have to do with tube sheets for isolating particular regions of a reactor pressure vessel.)

While USP Class is important, it is tied to the prosecution and review aspect of the filing and may be excluding aspects of the holdings. Accordingly, by looking at the full text of the filings, we may find other areas of interest for their portfolio. To do this, we produced the below "PatentScape" text clustering chart, showing a rendition of the most common words and phrases in the holdings.



In this PatentScape and the next two, each cell represents 3 grants (blue) or applications (yellow). The proximity of each cell to the center of the text cluster represents the degree to which the patents or patent applications in that cell deal with the text concept, with cells closer to the center of the cluster having more relevant references. This can help to show trends in patent filing; for example, if the cells closest to the center of the text cluster are mostly blue and the cells further away from the center of the text cluster are mostly yellow, this can indicate that the cluster

represents a mature field, with a developed core having many granted patents, which inventors are trying to apply to new tasks and applications.

From this, we can see that while TerraPower's overall portfolio is dominated by only two classes, the subject matter contained in each filing is extremely diverse when it comes to different aspects of the technology. For the most part, their grants and applications are fairly distributed across the PatentScape and subject areas. However, we can see that while there was heavy investment in the "fuel salt" area with a significant number of holdings total (107), there are relatively few granted patents. This could mean a few different things based on the filings.



Comparing this timeline to TerraPower's full timeline, we can see the role of "fuel salt" in TerraPower's IP investments. From the founding in 2006 until 2015, it played no role at all, but a major role over the next three years. We can now see that their major spike in 2017 filings was related to fuel salts. While there were fewer grants than the applications may have hoped, these granted patents are likely related to aspects TerraPower views as crucial to their role moving forward and may include some of their stronger holdings.

One such strong granted patent in this group is United States Patent Number 10,438,705 B2 for *Fission reaction control in a molten salt reactor*. From the specification, we learn that it pertains to a system for sustaining a nuclear fission reaction fueled by a molten fuel salt. Between the large filing spike and focus on fuel salts in 2017 and the strength of this individual patent, we can expect this area of technology to be notable and relevant in the coming decades.



IX. Spotlight For Insight: Chinese Patent Office Filers

With China's critical role as an SMR Market, it will be especially useful to know who those filers are to inform us about what who those key players may be within this key market moving forward. To do this, we can filter our dataset for applications filings at the China National Intellectual Property Administration, the Chinese Patent Office. Of the 882 total entities, this pie chart shows the top 20.



By sorting these according to their commercial or non-commercial roles, we can begin to see some trends. The following provide brief comments into some key aspects of what each of these 20 entities are and what their roles are.



1. Chinese Commercial Entities

- **Nuclear Power Institute of China** is a subsidiary of China Nation Nuclear Corporation, a state owned corporation founded in 1955.
- **CGN Power Co., Ltd.** is also a state-owned corporation (10%), but was listed on the U.S. Defense Department's list of corporations U.S. companies could not do business with for attempts to buy U.S. nuclear corporations to divert to military uses.
- **China Nuclear Power Technology Research Institute Co. Ltd** is a subsidiary of CGN Power.
- Suzhou Nuclear Power Research Institute Co. Ltd. and also named by the U.S. Defense Department's Entity List.
- Yantai Jeroh Official Oilfield Services Group Co., Ltd, is a Chinese oil equipment manufacturer without any publicly stated investment in nuclear power.
- **China Petrochemical Corporation of Sinopec Group** is the world's largest oil refining, gas, and petrochemical conglomerate, administered by the state and headquartered in Beijing.
- **Angang Steel Company Limited** is a state-supervised steel manufacturer, which produces the 2nd most steel in China.
- **Guangdong Nuclear Power Joint Venture Company** is run by equity invest firm Hong Kong Nuclear Investment Company, a wholly owned subsidiary of CLP Group-a Hong Kong based power company.
- Shanghai Nuclear Engineering Research & Design Institute is a subsidiary of State Power Investment Corporation through State Power Investment Corporation.
- **Jiangsu Hengli Chemical Fibre Co Ltd** is a subsidiary in chemical fiber of the Hengli Group, a textile giant.
- **China Nuclear Fuel Co Ltd** is a wholly own subsidiary of the China National Nuclear Corporation, which is the only manufacturer, supplier, and service provider of nuclear fuel in China.
- **CNNC Fujian Fuqing Nuclear Power co., LTD** runs the Fuqing Nuclear Power Co Ltd. power plant in Fuqing, China.

SMR Patent Landscape: Insight & Analysis

2. Chinese Non-commercial Entities

Xian Jiaotong University is a state owned university with multiple National Labs and Research Centers.

Chinese Academy of Sciences is the National Academy for the state.

Chinese Institute of Atomic Energy was formerly the atomic energy division of the Chinese Academy of Science before being restructured as the main research institute of the China National Nuclear Energy Corporation.

China Nuclear Power Institute is a division of the Chinese Institute of Atomic Energy.

Harbin Engineering University is a state-run university in Harbin, China, with a large portion of Russian international students.

Tsinghua University is one of China's C9 Universities.

Dalian University of Technology is one of China's Big Four Institutes of Technology.

North China Electric Power University is a national university focused on the development of nuclear power engineers.

With the context of who these entities are, we can now see that it is entirely occupied by

Chinese entities, both private and state-controlled, but with no foreign entities gaining a foothold

among the top twenty. Certainly, there may be more representation in the remaining 862 entities

outside the top 20, but the current landscape is dominated by these domestic Chinese filers. For

some further context about how significant each is in the current Market, we look to another

Bubble Chart.



In this chart, we see a tremendous spread along the Vision axis (left-right), but almost none on the Resources axis (up-down). This is likely a result of the "US Litigation" component, which is 0 for almost all of them. This may change as both markets advance and compete more directly. Further, as China's patent legal system continues to develop and patent enforcement takes a more prominent role, we may see some of these entities, especially the commercial ones, become more heavily abroad both domestically and abroad. This will boost their influence on Bubble Charts like this one in the future.

Finally, just as before in our filing sections, to gain an understanding of where the market may be heading in the future, we can limit our filings to those filed at the Chinese Patent Office in the last 5 years, a total of 910 applications. This produces the following heat map, which also shows their comparative revenue.



From this heat map, we can see that the dominance of Chinese entities in the SMR landscape seems likely to continue in the coming years. The Nuclear Power Institute of China, CGN Power Co., Ltd, and Xian Jiaotong each maintain a top spot among filers. Meanwhile, the China Institute of Atomic Energy looks to be gaining a more prominent role in SMR, while Yantai Jeroh drops out of the top 20 entirely. Finally, while Hualong Pressurized Water Reactor Technology Corporation had not yet made an appearance in our bigger picture look at Chinese filings, here we confirm our suspicions from the global SMR Bubble Chart in Section VI that Hualong would be a key player not just globally, but in the Chinese SMR Market specifically.

However, the most notable changes we see, is the appearance of Haldor Topsøe, a Danish company specializing in Chemicals, petrochemicals, fuels and oils, and natural gas. We may have expected the fossil fuel energy industries to show these signs of pivot towards green energy sources for growth and preservation purposes, but we also see a foreign entity taking interest in the heavy role China is likely to play moving forward. Haldor Topsøe may be among the first to gain a foothold into the Chinese SMR market and is likely to play a key role as others follow their lead to both to both the global and Chinese SMR markets.





X. Appendix: SMR "Key Player" IP Profile Dossiers

Appendix of Dossiers:

Table of Contents

Appendix Section	Key Player
A1	Toshiba Corporation
A2	Hitachi Inc.
A3	General Electric Corporation
A4	Orano SA (Areva SA)
A5	TerraPower, LLC
A6	Fluor Corporation (NuScale Power LLC)
A7	Babcock & Wilcox
A8	KEPCO Nuclear Fuel Co., Ltd.
A9	Rolls-Royce Group plc
A10	Holtec International

SMR Patent Landscape: Insight & Analysis

Maier & Maier

Spring 2021

A1. Toshiba Corporation

Website: https://www.toshiba.co.jp/ Annual Revenue: \$ 34,989,483,606 Employees: 141256 Market Cap: \$ 8,976,451,900 Location: Minato-ku, TKY, Japan



Trend Line Visualization

This visualization provides trending of the assets currently owned by the company. The trend is calculated by taking the assets created in the most recent 10 years. These assets are normalized for comparison by taking the percentage of the total per year. A flat trend would thus be a straight line with a y-value of approximately 10%.

Year	Patents	Litigation	Trademarks
2012	131% - 24,206	112% - 28	115% - 61
2013	129% - 23,786	199% - 50	164% - 87
2014	124% - 23,013	167% - 42	129% - 68
2015	110% - 20,372	175% - 44	117% - 62
2016	91% - 16,848	127% - 32	64% - 34
2017	91% - 16,766	72% - 18	74% - 39
2018	80% - 14,743	16% - 4	61% - 32
2019	77% - 14,191	12% - 3	78% - 41
2020	67% - 12,439	20% - 5	98% - 52
2021 * Forecast calculation	48% - 1,988 actual (8,849 est.)	35% - 2 actual (9 est.)	84% - 10 actual (45 est.)

Patent Portfolio

Total: 949814 (Active: 13% - 123596, Expired: 86% - 826218)

Recent Patents:

2021-03-23 US10952695: Medical apparatus and method 2021-03-23 US10953652: Ink jet head and ink jet printer 2021-03-23 US10953653: Ink jet head and ink jet printer 2021-03-23 US10955383: Detection device, detection system, and detection method US10955491: Method for detecting a meter maintenance condition using winding resistance 2021-03-23 US10955772: Belt positioning structure, belt and roller unit, and image forming apparatus 2021-03-23 2021-03-23 US10955779: Image forming apparatus configured to determine heater elements to be energized and image forming method performed thereby 2021-03-23 US10955782: Fixing device and image forming apparatus 2021-03-23 US10955788: Image forming apparatus having motor controller, paper conveyance method, and non-transitory computer readable medium 2021-03-23 US10956729: Data processing apparatus and method, and non-transitory computer readable medium

Top Inventors: (Unknown: 10670, Hideo Ando: 3665, Norio Takami: 2873, Yoshihiro Kikuchi: 2165, Takeshi Chujoh: 1690, Shinichiro Koto: 1664, Yasuhiro Harada: 1264, Shinichi Kikuchi: 1237, Katsuya Okumura: 1192, Takeshi Nakajo: 1170)

Patent Litigation

Total: 474 (Plaintiff: 16% - 80, Defendant: 74% - 352)

Plaintiff Statistics: Win: 0, Loss: 80 (Dismissal: 17, Stipulated Dismissal: 10, Transferred: 3, Judgment: 27, Plaintiff Voluntary Dismissal: 3, Stay: 1, Consolidation: 3, Interdistrict Transfer: 1, Settled: 13)

Defendant Statistics: Win: 4, Loss: 348 (Appeal: 14, Dismissal: 121, Interdistrict Transfer: 5, Stipulated Dismissal: 60, Consent Judgment: 2, Plaintiff Voluntary Dismissal: 37, Transferred: 19, Settled: 8, Judgment: 17, Stay: 8, Claimant Wins: 1, Consolidation: 7, Dropped: 1)

Award range: \$0 - \$26,184,297

Penalty range: \$0 - \$26,184,297

Trademark Portfolio

Total: 2026 (Pending: 4% - 88, Registered: 22% - 462, Dead: 72% - 1476)

Recent Trademarks:

2021-03-18	90586816: ASSETLIFE
2021-03-18	90586819: WORKLIFE
2021-03-15	90579833: STORE PRINTEXPO
2021-03-05	90563419: ELEVATE SKY
2021-02-09	90520424: BRIGADE
2021-02-08	90518197: ASSURING AI
2021-01-26	90489134: ECONNECT TOUCHFREE
2021-01-26	90489299: MYBEAUTYOLOGY
2021-01-14	90465634: ELERA
2021-01-06	90450783: SMARTMCD

Spring 2021

A2. Hitachi Inc.

Website: http://www.hitachi.com/ Market Cap: Unknown Annual Revenue: \$ 80,407,855,550 Location: Chiyoda-ku, TKY, Japan **Employees:** 295941



Trend Line Visualization

This visualization provides trending of the assets currently owned by the company. The trend is calculated by taking the assets created in the most recent 10 years. These assets are normalized for comparison by taking the percentage of the total per year. A flat trend would thus be a straight line with a y-value of approximately 10%.

Year	Patents	Litigation	Trademarks
2012	122% - 32,401	79% - 12	116% - 43
2013	120% - 31,860	92% - 14	94% - 35
2014	114% - 30,070	53% - 8	94% - 35
2015	98% - 25,890	53% - 8	107% - 40
2016	96% - 25,399	53% - 8	91% - 34
2017	96% - 25,470	171% - 26	102% - 38
2018	87% - 22,970	276% - 42	91% - 34
2019	87% - 23,037	79% - 12	105% - 39
2020	80% - 21,257	46% - 7	99% - 37
2021 * Forecast calculation	56% - 3,338 actual (14,858 est.)	58% - 2 actual (9 est.)	36% - 3 actual (13 est.)

Patent Portfolio

Total: 1154425 (Active: 15% - 180571, Expired: 84% - 973854)

Recent Patents: 2021-03-23 US10952694: Method and apparatus for correcting computed tomography image 2021-03-23 US10953630: Method for manufacturing clad material 2021-03-23 US10953822: Electronic control device and assembly method thereof 2021-03-23 US10953897: Electronic circuit controller for railway switch machine, railway switch machine and railway switching system including same 2021-03-23 US10954671: Vibration isolation supporting structure and vibration isolation system 2021-03-23 US10955016: Disc brake 2021-03-23 US10955243: Inertial sensor 2021-03-23 US10955342: Light detection device US10955361: Defect inspection apparatus and pattern chip 2021-03-23 2021-03-23 US10955401: Chemical for test used in hazardous substance sensing device, hazardous substance sensing device, and hazardous substance sensing method

Top Inventors: (Unknown: 3920, Hiroshi Watanabe: 2077, Akira Yamamoto: 1624, Hiroshi Suzuki: 1365, Takeshi Maeda: 1358, Koji Hirata: 1332, Akira Nagai: 1311, Hiroo Higashitotsuka Okamoto: 1273, Hiroshi Sasaki: 1264, Masahiro Watanabe: 1221)

Patent Litigation

Total: 278 (Plaintiff: 20% - 58, Defendant: 74% - 208)

Plaintiff Statistics: Win: 0, Loss: 58 (Transferred: 4, Dismissal: 25, Stipulated Dismissal: 6, Interdistrict Transfer: 1, Plaintiff Voluntary Dismissal: 4, Claim Defendant Win: 1, Settled: 3, Judgment: 4, Appeal: 1)

Defendant Statistics: Win: 5, Loss: 203 (Dismissal: 58, Interdistrict Transfer: 2, Stipulated Dismissal: 18, Settled: 8, Claimant Wins: 1, Judgment: 5, Appeal: 3, Transferred: 8, Plaintiff Voluntary Dismissal: 23, Stay: 2, Default Judgment: 1, Dropped: 12)

Award range: \$0 - \$0

Penalty range: \$0 - \$35,000,000

Trademark Portfolio

Total: 2206 (Pending: 2% - 55, Registered: 20% - 445, Dead: 77% - 1706)

Recent Trademarks:

2021-02-23	90540920: TECHNICAL PRECISION
2021-01-26	90489344: MAGNETIC TECH SOLUTIONS
2021-01-12	90461304: EXTOPE
2020-11-30	90348215: VELOCITY OASIS
2020-11-24	79304009: SILMED
2020-11-05	90300587: UD
2020-10-12	90248511: LUMADA INNOVATION HUB
2020-10-08	90243466: CHARGE AI CLIP
2020-10-05	90236569: CALM
2020-09-24	90206371: EVERFLEX



Spring 2021

A3. General Electric Corporation

 Website:
 https://www.ge.com/
 Market Cap: \$ 117,041,130,000

 Annual Revenue:
 \$ 95,214,000,000
 Location: Boston, MA, United States

 Employees:
 205000
 Location: Boston, MA, United States



Trend Line Visualization

This visualization provides trending of the assets currently owned by the company. The trend is calculated by taking the assets created in the most recent 10 years. These assets are normalized for comparison by taking the percentage of the total per year. A flat trend would thus be a straight line with a y-value of approximately 10%.

Year	Patents	Litigation	Trademarks
2012	107% - 19,321	103% - 25	131% - 152
2013	111% - 19,969	54% - 13	96% - 112
2014	102% - 18,408	87% - 21	117% - 136
2015	98% - 17,675	70% - 17	177% - 206
2016	110% - 19,742	268% - 65	112% - 130
2017	114% - 20,588	54% - 13	92% - 107
2018	97% - 17,510	169% - 41	58% - 67
2019	87% - 15,610	78% - 19	53% - 62
2020	74% - 13,356	17% - 4	63% - 73
2021 * Forecast calculation	48% - 1,960 actual (8,724 est.)	18% - 1 actual (4 est.)	15% - 4 actual (18 est.)

Patent Portfolio

Total: 528743 (Active: 19% - 105452, Expired: 80% - 423291)

Recent Patents:

2021-03-23 USD914053: Display screen or portion thereof with transitional graphical user interface 2021-03-23 US10952705: Method and system for creating and utilizing a patient-specific organ model from ultrasound image data US10953437: Screening device for the generative manufacturing of components 2021-03-23 2021-03-23 US10953483: Tool electrode for and methods of electrical discharge machining 2021-03-23 US10953604: System and method for additive production of three-dimensional objects with graphical display 2021-03-23 US10953611: Blade mould for manufacturing a blade shell part of a wind turbine blade and related method 2021-03-23 US10953995: Propulsion system for an aircraft 2021-03-23 US10954168: Ceramic matrix composite articles and methods for forming same 2021-03-23 US10954724: Axial and rotational alignment system and method 2021-03-23 US10954732: Hydraulically set open hole whipstock

Top Inventors: (Unknown: 17559, Detlev Marpe: 1852, Ajith Kuttannair Kumar: 1689, Ching-Pang Lee: 1256, Ronald Scott Bunker: 1212, Evangelos Trifon Laskaris: 1086, Jiang Hsieh: 973, Rocco Difoggio: 952, Heiner Kirchhoffer: 945, Srikanth Chandrudu Kottilingam: 904)

Patent Litigation

Total: 524 (Plaintiff: 41% - 217, Defendant: 54% - 284)

Plaintiff Statistics: Win: 7, Loss: 210 (Consolidation: 2, Summary Judgment: 1, Claim Defendant Win: 2, Stipulated Dismissal: 17, Dismissal: 64, Judgment: 47, Transferred: 5, Plaintiff Voluntary Dismissal: 6, Consent Judgment: 7, Appeal: 2, Settled: 14, Dropped: 24)

Defendant Statistics: Win: 10, Loss: 274 (Dismissal: 95, Consolidation: 4, Stipulated Dismissal: 22, Plaintiff Voluntary Dismissal: 19, Judgment: 39, Transferred: 13, Consent Judgment: 2, Settled: 9, Summary Judgment: 1, Stay: 2, Claimant Wins: 1, Claim Defendant Win: 3, Appeal: 2, Dropped: 11)

Award range: \$0 - \$166,750,000

Penalty range: \$0 - \$35,000,000

Trademark Portfolio

Total: 10367 (Pending: 1% - 172, Registered: 23% - 2396, Dead: 75% - 7799)

Recent Trademarks:

2021-03-01	90552423: TRAVELLER
2021-02-11	90525091: LOGIQ FORTIS
2021-01-13	90464071: PETFLODAZ
2021-01-07	90452430: G2POWER
2020-12-29	90424041: MLILY KIDS
2020-12-22	90402351: GE
2020-12-22	90402360: GE
2020-12-22	90402363: GE
2020-12-22	90402367: GE
2020-12-22	90402372: GE

SMR Patent Landscape: Insight & Analysis Maier & Maier

Spring 2021

A4. Orano SA

Website:Market Cap: UnknownAnnual Revenue:\$ 4,143,951,170Location: Paris, FranceEmployees:18793



Trend Line Visualization

This visualization provides trending of the assets currently owned by the company. The trend is calculated by taking the assets created in the most recent 10 years. These assets are normalized for comparison by taking the percentage of the total per year. A flat trend would thus be a straight line with a y-value of approximately 10%.

Year	Patents	Litigation	Trademarks
2012	135% - 661	-	41% - 1
2013	132% - 645	-	205% - 5
2014	152% - 741	-	82% - 2
2015	133% - 650	-	123% - 3
2016	126% - 618	-	41% - 1
2017	101% - 495	-	82% - 2
2018	64% - 315	-	123% - 3
2019	36% - 174	-	164% - 4
2020	20% - 99	-	41% - 1
2021	13% - 14 actual (62 est.)	-	-

Spring 2021

Patent Portfolio

Total: 11959 (Active: 24% - 2911, Expired: 75% - 9048)

Recent Patents:

2021-03-17 EP2561575: Device for storing and restoring electrical energy 2021-03-03 JP6836992: How to make pellets of at least one type of metal oxide 2021-03-02 CA2878121: Nuclear plant with a containment shell and with a pressure relief system 2021-03-02 CA2920314: Method for detecting temporally varying thermomechanical stresses and/or stress gradients over the wall thickness of metal bodies 2021-03-02 CA2955369: Convective dry filtered containment venting system 2021-02-25 KR102220826: Method and device for repairing damage to a container wall located under water 2021-02-19 CN107667074: Tool for smoothing in radioactive environments comprising a vibrating grid 2021-02-18 JP2021505509: Method for preparing powder containing triuranium octoxide particles and plutonium dioxide particles JP6828030: Cooling element with base to dissipate heat from the package 2021-02-10 2021-02-09 KR102214167: Ultrasound transducer

Top Inventors: (Bernd Eckardt: 181, Mihai G M Pop: 148, Axel Hill: 143, Erhard Friedrich: 137, Unknown: 108, Rainer Gassen: 100, Franz Strohmer: 98, Jacques Foos: 92, Alain Guy: 92, Thierry Muller: 92)

Patent Litigation

Total: 2 (Plaintiff: 100% - 2, Defendant: 0% - 0)

Plaintiff Statistics: Win: 0, Loss: 2 (Dismissal: 1)

Award range: \$0 - \$0

Trademark Portfolio

Total: 123 (Pending: 0% - 1, Registered: 29% - 36, Dead: 69% - 86)

Recent Trademarks:

2020-07-31	90086334: CERCA
2019-10-31	79275115: INWOOD
2019-10-31	79275394: INWOOD HOTELS
2019-05-14	79262470: TN LAB
2019-01-23	79253685: TN MW
2018-11-19	79251502: TN EAGLE
2018-09-30	88137631: UG PLAST
2018-09-30	88137650: BORREX
2017-10-17	79227437: QUANTOM
2017-10-10	87639761: N-VISION



Spring 2021

A5. TerraPower, LLC

Website: http://www.terrapower.com/ Market Cap: Unknown Annual Revenue: Unknown Location: Bellevue, WA, United States Employees: Unknown



Trend Line Visualization

This visualization provides trending of the assets currently owned by the company. The trend is calculated by taking the assets created in the most recent 10 years. These assets are normalized for comparison by taking the percentage of the total per year. A flat trend would thus be a straight line with a y-value of approximately 10%.

Year	Patents	Litigation	Trademarks
2012	53% - 37	-	-
2013	23% - 16	-	129% - 1
2014	34% - 24	-	-
2015	61% - 43	-	-
2016	111% - 78	-	-
2017	156% - 110	-	-
2018	183% - 129	-	129% - 1
2019	149% - 105	-	257% - 2
2020	131% - 92	-	386% - 3
2021	70% - 11 actual (49 est.)	-	-

Patent Portfolio

Total: 716 (Active: 56% - 405, Expired: 43% - 311)

Recent Patents:

2021-03-04	WO2021040911: Sodium vaporizer and method for use of sodium vaporizer
2021-03-03	EP3542371: Thermal management of molten fuel nuclear reactors
2021-02-25	US20210057117: Sodium vaporizer and methods
2021-02-23	US10930403: Iron-based composition for fuel element
2021-02-22	JP2021507234: Cyclic metal nuclear fuel and its manufacturing method
2021-02-18	US20210047568: Flexible pyrolysis system and method
2021-02-16	US10923238: Direct reactor auxiliary cooling system for a molten salt nuclear reactor
2021-02-12	JP2021503556: Sodium-tin and sodium-tin-lead coolants
2021-01-28	AU2015372569: Targetry coupled separations
2021-01-21	AU2019343906: Corrosion-resistant coolant salt and method for making same

Top Inventors: (Joshua C Walter: 232, Roderick A Hyde: 225, Jon D McWhirter: 161, Charles Whitmer: 152, Muriel Y Ishikawa: 137, Lowell L Jr Wood: 132, George B Zimmerman: 124, Nathan P Myhrvold: 122, Robert C Petroski: 120, David G McAlees: 106)

Patent Litigation

No patent litigation.

Trademark Portfolio

Total: 9 (Pending: 11% - 1, Registered: 66% - 6, Dead: 22% - 2)

Recent Trademarks:

2020-07-07	90040259: NATRIUM
2020-01-27	88774450: TERRAPOWER
2020-01-27	88774455: TERRAPOWER
2019-09-10	88611782: OPENARMI
2019-01-10	88256845: TERRAPOWER ISOTOPES
2018-10-05	88144692: ARMI
2013-06-18	85962926: TERRAPOWER
2008-04-22	77454913: TERRAPOWER
2008-01-25	77380933: TERRAPOWER



Spring 2021

A6. Fluor Corporation (*NuScale Power LLC*)

Website: http://www.fluor.com/Pages/Default.aspx Market Cap: \$ 8,044,400,000 Annual Revenue: \$ 19,166,599,000 Employees: 53349



Trend Line Visualization

This visualization provides trending of the assets currently owned by the company. The trend is calculated by taking the assets created in the most recent 10 years. These assets are normalized for comparison by taking the percentage of the total per year. A flat trend would thus be a straight line with a y-value of approximately 10%.

Year	Patents	Litigation	Trademarks
2012	100% - 216	450% - 1	300% - 15
2013	118% - 255	-	-
2014	112% - 242	450% - 1	40% - 2
2015	105% - 228	-	180% - 9
2016	109% - 236	-	60% - 3
2017	102% - 221	-	60% - 3
2018	111% - 241	-	120% - 6
2019	83% - 179	-	20% - 1
2020	61% - 133	-	20% - 1
2021 * Forecast calculation	27% - 13 actual (58 est.)	-	89% - 1 actual (4 est.)

Spring 2021

Patent Portfolio

Total: 4287 (Active: 27% - 1185, Expired: 72% - 3102)

Recent Patents:

2021-03-09	US10941041: Method of manufacturing graphene using photoreduction
2021-03-03	EP3005375: Inspecting a steam generator
2021-03-02	US10935677: Image plate calibration system
2021-02-25	KR102220520: Steam generator for a nuclear reactor
2021-02-18	ES2806623: Inclined tube sheet steam generator
2021-02-08	PL3329494: Control rod position indicator
2021-02-04	US20210032103: Formation of high quality alane
2021-02-04	WO2021022006: Formation of high quality alane
2021-02-03	EP3563390: Bolt installation and tensioning system
2021-01-15	CL2020001717:

Top Inventors: (John Mak: 851, Satish Reddy: 235, Curt Graham: 123, John T Groome: 116, Richard B Nielsen: 115, Ravi H Ravikumar: 106, Eric Paul Young: 105, Thomas King Chow: 100, Garry Edward Jacobs: 95, Vincent Wai Wong: 92)

Patent Litigation

Total: 3 (Plaintiff: 0% - 0, Defendant: 100% - 3)

Defendant Statistics: Win: 0, Loss: 3 (Dismissal: 2, Judgment: 1)

Penalty range: \$0 - \$0

Trademark Portfolio

Total: 159 (Pending: 3% - 6, Registered: 33% - 54, Dead: 62% - 99)

Recent Trademarks:

90476605: HUMAN PROJECT
90380953: EPHD
88543643: VIDAMAMI
87916566: FRES CO
87916584: FRES CO
87908198: N
87908213: POWER FOR ALL HUMANKIND
87908221: NUSCALE POWER
87908226: NU
87583067: NUFUEL-HTP2



Spring 2021

A7. Babcock & Wilcox Enterprises, Inc.

Website: http://www.babcock.com/ Market Cap: \$ 451,700,000 Annual Revenue: \$ 859,111,000 Location: Charlotte, NC, United States Employees: 2400



Trend Line Visualization

This visualization provides trending of the assets currently owned by the company. The trend is calculated by taking the assets created in the most recent 10 years. These assets are normalized for comparison by taking the percentage of the total per year. A flat trend would thus be a straight line with a y-value of approximately 10%.

Year	Patents	Litigation	Trademarks
2012	88% - 161	-	168% - 11
2013	94% - 172	-	76% - 5
2014	147% - 267	-	107% - 7
2015	119% - 216	-	92% - 6
2016	127% - 231	-	92% - 6
2017	129% - 235	-	153% - 10
2018	83% - 151	-	92% - 6
2019	77% - 140	-	15% - 1
2020	36% - 66	-	107% - 7
2021	32% - 13 actual (58 est.)	-	-

Patent Portfolio

Total: 22467 (Active: 6% - 1400, Expired: 93% - 21067)

Recent Patents:

2021-03-23	US10956803: Modular rocket rescue system and passenger safety wearable band
2021-03-16	US10948253: Sensor system for advanced smart weapons barrels
2021-03-11	WO2021046251: Steam condensation system with integrated condensate manifold
2021-03-09	US10939718: Modular helmet interface
2021-03-09	US10942005: Combined reflex and laser sight with co-aligned iron sights
2021-03-02	ES2808907: Mobile rack for an oven
2021-02-17	EP3776297: Weapon system with operator identification
2021-02-17	KR20210018188: Improved adsorbent utilization by selective recirculation of ash from particulate
collector	
2021-01-26	CA2845359: Chemical looping processes for partial oxidation of carbonaceous fuels
2021-01-19	BR112013024727: Collection electrode for a wet electrostatic precipitator

Top Inventors: (Unknown: 4008, Felix Stanley Jabsen: 324, Mikhail Walker Davi Maryamchik: 264, David Schenck Jacobus: 229, Donald C Schluderberg: 219, Howard James Kerr: 215, Melvin John Albrecht: 204, David J Walker: 202, Alexander C Kiplin: 199, James W Teetzel: 189)

Patent Litigation

Total: 6 (Plaintiff: 50% - 3, Defendant: 50% - 3)

Plaintiff Statistics: Win: 0, Loss: 3 (Dismissal: 3)

Defendant Statistics: Win: 0, Loss: 3 (Dismissal: 1, Stipulated Dismissal: 1)

Award range: \$0 - \$0

Penalty range: \$0 - \$0

Trademark Portfolio

Total: 333 (Pending: 2% - 8, Registered: 20% - 67, Dead: 77% - 258)

Recent Trademarks:

2020-11-13	90317880: B&W RENEWABLE BABCOCK & WILCOX
2020-11-13	90317955: B&W BABCOCK & WILCOX ENVIRONMENTAL
2020-11-13	90318060: B & W THERMAL BABCOCK & WILCOX
2020-11-13	90318103: B&W BABCOCK & WILCOX
2020-06-03	88946378: ATLUS
2020-03-31	88853746: SAVR
2020-03-31	88853748: PATRIOT SAVR
2019-03-25	88355010: AIREJET
2018-07-26	79245497: DYNAFEEDER
2018-07-26	79245833: DYNADISCHARGER



Spring 2021

A8. KEPCO Nuclear Fuel Co., Ltd.

 Website:
 Market Cap: Unknown

 Annual Revenue:
 Unknown

 Location:
 DAEJEON, South Korea

 Employees:
 Unknown



Trend Line Visualization

This visualization provides trending of the assets currently owned by the company. The trend is calculated by taking the assets created in the most recent 10 years. These assets are normalized for comparison by taking the percentage of the total per year. A flat trend would thus be a straight line with a y-value of approximately 10%.

Year	Patents	Litigation	Trademarks
2012	69% - 46	-	-
2013	106% - 71	-	-
2014	103% - 69	-	-
2015	40% - 27	-	-
2016	116% - 78	-	-
2017	85% - 57	-	-
2018	110% - 74	-	-
2019	119% - 80	-	-
2020	151% - 101	-	-
2021	73% - 11 actual (49 est.)	-	-

Patent Portfolio

Total: 709 (Active: 53% - 379, Expired: 46% - 330)

Recent Patents:

2021-03-17 EP3792614: Apparatus for fatigue testing bulge tool having wh-type skeleton 2021-03-04 US20210065920: Nuclear fuel rod end distance adjusting device 2021-02-24 KR20210020195: Spacer grid of a nuclear fuel assembly 2021-02-23 KR20210019746: Spacer grid of a nuclear fuel assembly US20210050120: Nuclear fuel pellet having excellent compression resistance and reduced surface 2021-02-18 defect 2021-02-18 US20210050121: Nuclear fuel sintered pellet having excellent impact resistance 2021-02-18 WO2021029485: Support lattice of nuclear fuel assembly KR102213904: Automatic cutting method and apparatus of nuclear fuel rod tube 2021-02-09 2021-02-02 US10907770: Device for maintaining internal temperature of pressure vessel 2021-01-28 JP2021502563: Method for measuring recrystallization of zirconium alloy cladding tube for nuclear fuel utilizing ebsd pattern quality

Top Inventors: (Nam Gyu Park: 76, Seong Soo Kim: 76, Kyong Bo Eom: 70, Jong Sung Yoo: 69, Yong Kyoon Mok: 68, Tae Sik Jung: 67, Jin Sun Kim: 66, Jung Min Suh: 65, Joo Young Ryu: 65, Dong Geun Ha: 64)

Patent Litigation

No patent litigation.

Trademark Portfolio

No trademarks.

SMR Patent Landscape: Insight & Analysis Maier & Maier

Spring 2021

A9. Rolls-Royce Group plc

Website: https://www.rolls-royce.com/ Annual Revenue: \$ 21,778,731,000 Employees: 51700 Market Cap: \$ 32,330,000,000 Location: London, ENG, United Kingdom



Trend Line Visualization

This visualization provides trending of the assets currently owned by the company. The trend is calculated by taking the assets created in the most recent 10 years. These assets are normalized for comparison by taking the percentage of the total per year. A flat trend would thus be a straight line with a y-value of approximately 10%.

Year	Patents	Litigation	Trademarks
2012	77% - 1,685	-	-
2013	73% - 1,584	300% - 1	129% - 5
2014	85% - 1,847	-	51% - 2
2015	78% - 1,700	300% - 1	180% - 7
2016	104% - 2,266	300% - 1	154% - 6
2017	98% - 2,146	-	129% - 5
2018	117% - 2,552	-	103% - 4
2019	135% - 2,945	-	129% - 5
2020	134% - 2,913	-	26% - 1
2021	90% - 443 actual (1,972 est.)	-	-

SMR Patent Landscape: Insight & Analysis

Maier & Maier

Spring 2021

Patent Portfolio

Total: 48021 (Active: 24% - 11880, Expired: 75% - 36141)

Recent Patents:

2021-03-23 US10953613: Cutting mechanism with rotatable blades 2021-03-23 US10954794: Rotor blade arrangement 2021-03-23 US10954798: Gas turbine engine with optimized fan blade geometry US10954802: Turbine section assembly with ceramic matrix composite vane 2021-03-23 2021-03-23 US10954803: Abrasive coating for high temperature mechanical systems 2021-03-23 US10954809: Ceramic matrix full hoop blade track 2021-03-23 US10954811: Measuring device and measuring method for a flow US10954813: Planetary gearbox system and method for operating a planetary gearbox system 2021-03-23 2021-03-23 US10954885: Flow guiding device and method for forming a flow guiding device 2021-03-23 US10954964: Gas turbine engine and panel for a gas turbine engine

Top Inventors: (Unknown: 2767, Daniel N S Clark: 415, John Richard Webster: 329, Ted Joseph Freeman: 311, Ian Colin Deuchar Care: 308, Daniel K Vetters: 301, Volker Guemmer: 292, Karl Schreiber: 284, David J Thomas: 272, Predrag Todorovic: 255)

Patent Litigation

Total: 25 (Plaintiff: 20% - 5, Defendant: 76% - 19)

Plaintiff Statistics: Win: 1, Loss: 4 (Consent Judgment: 1, Appeal: 1, Plaintiff Voluntary Dismissal: 1, Stipulated Dismissal: 1)

Defendant Statistics: Win: 0, Loss: 19 (Appeal: 2, Dismissal: 6, Transferred: 1, Consolidation: 1, Judgment: 3, Stipulated Dismissal: 1)

Award range: \$0 - \$0

Penalty range: \$0 - \$34,000,000

Trademark Portfolio

Total: 172 (Pending: 1% - 2, Registered: 48% - 83, Dead: 50% - 87)

Recent Trademarks:

2020-10-01 90230402: CMIS 2019-11-12 88688443: RR CULLINAN 2019-09-25 88629880: VISIUMKMS 2019-01-25 88276660: ARTIFICIAL CHIEF ENGINEER 79252927: PIONEERS OF POWER 2019-01-10 2019-01-10 79255557: ROLLS ROYCE RR PIONEERS OF POWER 2018-08-14 88077927: BANSHEE 2018-08-02 79242107: PEARL 87923860: CONFIGURATION MANAGEMENT INTERFACE SYSTEM 2018-05-16 2018-05-16 87923900: CMIS



Spring 2021

A10. Holtec International

 Website:
 Market Cap: Unknown

 Annual Revenue:
 Unknown

 Location:
 United States

 Employees:
 Unknown



Trend Line Visualization

This visualization provides trending of the assets currently owned by the company. The trend is calculated by taking the assets created in the most recent 10 years. These assets are normalized for comparison by taking the percentage of the total per year. A flat trend would thus be a straight line with a y-value of approximately 10%.

Year	Patents	Litigation	Trademarks
2012	5% - 1	-	-
2013	-	-	-
2014	14% - 3	-	-
2015	36% - 8	-	-
2016	86% - 19	_	-
2017	118% - 26	-	-
2018	150% - 33	-	-
2019	186% - 41	-	-
2020	205% - 45	-	-
2021	283% - 14 actual (62 est.)	-	-

Spring 2021

Patent Portfolio

Total: 197 (Active: 53% - 106, Expired: 46% - 91)

Recent Patents:

2021-03-16	US10050361: High-density subterranean storage system for nuclear fuel and radioactive waste
2021 05 10	0510950501. Fight density subterratean storage system for fudicative waste
2021-03-11	US20210074444: Method of retrofitting a spent nuclear fuel storage system
2021-03-09	US10939787: System for low profile translation of high level radioactive waste
2021-03-04	WO2021041285: Radiation shielded enclosure for spent nuclear fuel cask
2021-02-25	US20210057118: Nuclear materials apparatus and implementing the same
2021-02-25	US20210057120: Radiation shielded enclosure for spent nuclear fuel cask
2021-02-25	WO2021034764: Portable robotic welder for nuclear waste handling
2021-02-18	US20210046569: Portable robotic welder for nuclear waste handling
2021-02-17	KR20210018453: Multi-part cask for storage and transportation of spent nuclear fuel
2021-02-04	US20210031315: Air cooled condenser and related methods

Top Inventors: (Krishna P Singh: 176, Indresh Rampall: 19, Richard M Springman: 19, Stephen J Agace: 17, Joseph B A Rajkumar: 14, Joseph Rajkumar: 12, John D Griffiths: 11, Stephen John Agace: 11, Vytautas Vincas MacIunas: 11, P. Stefan Anton: 10)

Patent Litigation

No patent litigation.

Trademark Portfolio

Total: 1 (Pending: 0% - 0, Registered: 0% - 0, Dead: 100% - 1)

Recent Trademarks: 1998-09-18 75574178: STARLIFT