Uranium (Nuclear and REE) Committee 2020 Report[1] Update
September-October 2020

UCOM Chairman:

- *Michael D. Campbell, P.G., P.H., C.P.G., I2M Consulting, LLC, Chief Geologist (Mining) / Chief Hydrogeologist (Environmental), Houston, TX*
  Ex-Teton Exploration Div., United Nuclear Corporation, and Texas Eastern Nuclear, Inc., DuPont,
  Founding Member of EMD in 1977, Past President of EMD (2010-11), and UCOM Chair since 2004.

UCOM Vice-Chairs:

- *Henry M. Wise, P.G., C.P.G., (Vice-Chair: Industry), US Ecology, TX (Founding Member, ex-US Steel, Uranium Div.)*
- *Steven S. Sibray, P.G., C.P.G., (Vice-Chair: University), University of Nebraska, Lincoln, NE*
- *Robert W. Gregory, P.G., (Vice-Chair: Government), Wyoming State Geological Survey, WY*

Members Contributing from the UCOM Advisory Group:

- *Roger W. Lee, Ph.D., P.G., Consulting Geochemist, Austin, TX*
- *James L. Conca, Ph.D., Consulting Nuclear Geoscientist, Richland, WA*

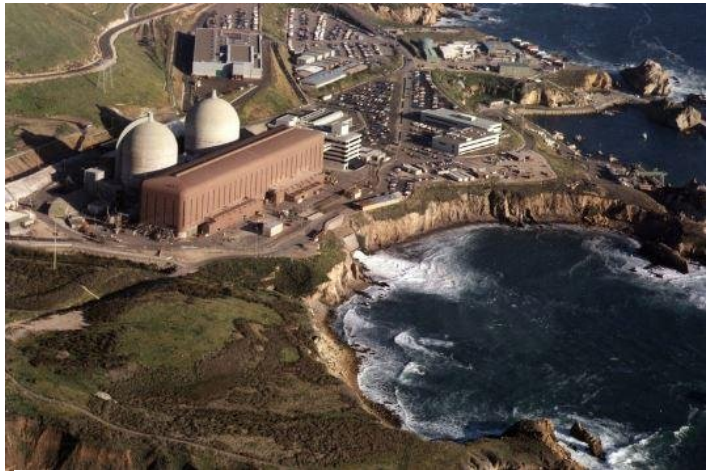
Beyond Hydrocarbons? …. The Rest of the Story

"Let's face it, nuclear power is in competition with natural gas and renewables," said Michael D. Campbell, Energy Minerals Division's Chairman of the Uranium (Nuclear & REE) Committee[2], and Chief Geologist / Chief Hydrogeologist of I2M Consulting, LLC,[12] in Houston during a recent AAPG-EMD Virtual Conference,[11] and briefly summarized in *The Explorer*.[71, pp. 2-3] Stimulated by the article to provide greater detail, Campbell indicated that there is a big move on nuclear power again these days. This is based on the committee's monitoring of energy developments over the past few years that the general public must re-evaluate their perceptions of earlier problems now that industry has grown technologically, emerging with greater abilities to lower risks and better manage nuclear incidents,[11 and 52] such as at Three-Mile Island[3] in Pennsylvania (1979) and Fukushima[4] in Japan (2011)." Campbell stressed that despite excessive negative media coverage and noise from agenda-driven anti-nuclear groups,[47] combined with a few members of the political left[21] who claim that renewables are the sole panacea to our climate-friendly energy needs of the future, nuclear power plants have safely generated electricity 24/7 over some 40 years of operation to customers throughout the U.S. and the world, contrary to the poor yearly safety records of coal, natural gas, and renewables (wind and solar).

Campbell indicated that the Committee has concluded that nuclear power is in fact a safe, sustainable, reliable, climate- and business-friendly[15] source of energy, which will be fueled by new discoveries that will provide hundreds of years of available uranium resources from a variety of secure sources.[69]

Incidents of the Past

The incidents of the past did not involve any radiation injuries or fatalities.[8] (The Chernobyl disaster in 1986, he reminded, was a result of expedient Soviet-era[9] designs and mismanagement of operations not solely to generate electricity but also plutonium for nuclear weapons).[13] Over the past decades, uranium mining and some 95 nuclear power reactors in operation today in the U.S., and some 441 in operation worldwide (plus 54 under construction in China, Russia, India, etc.), all together have demonstrated safety records far exceeding those of natural gas[25] (line explosions, methane emissions, and climate-unfriendly from burning and adding CO_2 to the atmosphere), coal[27] (underground mining accidents and also climate un-friendly from burning), and renewables (wind and solar)[6] in terms of injuries and fatalities during construction and repairs and inherent failings of the technologies[17]), Campbell emphasized during the recent conference. Even two new reactors are expected to be in operation in the Georgia-South Carolina area over the next few years to underscore the growing interest in nuclear power in the U.S.[34]



The Only Operating Nuclear Power Plant in California Located Many Miles from the San Andreas Fault Zone.

Competition for the Power Grid

Serious competition is now underway to determine which energy source will dominate the power-grid of the foreseeable future. With coal declining rapidly, only natural gas, uranium (and nuclear power[5]), hydroelectric power[53] and renewables (wind[16] and solar[7]) are in the running. Both natural gas and nuclear power are providing back-up to the power grid because of the inherent drawbacks of wind and solar, (where the former does not blow all the time and the latter is intermittent because there are cloudy days and the sun only shines during the day, of course)[6]. Because California has retired many of their nuclear power plants based on ill-founded, unsound reasons, burning natural gas has taken their place in the power grid in supporting California's unstable renewable energy systems.[23]

Inherent Failings

Renewables' inherent failings have also been made even more apparent by the need for back-up batteries during zero or low-power output, which are unusually expensive to buy and maintain. Furthermore, as recently constructed wind and solar projects mature, the cost of the electricity they are producing is going up rapidly, not only because of low energy conversion production efficiencies, but also because the costs of operation and maintenance of these projects have been overlooked and underestimated during the economic evaluations in the project design stages. This makes cost comparisons between large-scale wind and solar projects and nuclear power artificial and illogical without including the O&M costs.

Their O&M costs are just recently becoming evident in many such projects, such as in California, Germany,[23,22] etc., where the former is experiencing increased consumer electricity costs but also black-outs and power interruptions because their renewable systems cannot produce sufficient power at critical times when needed. As far as claims that competition is driving down the capital costs of wind and solar projects, it also follows that the quality of the equipment is decreasing. With this decrease in quality of the wind turbines and gear boxes, etc., operation and maintenance[24] needs are also likely to

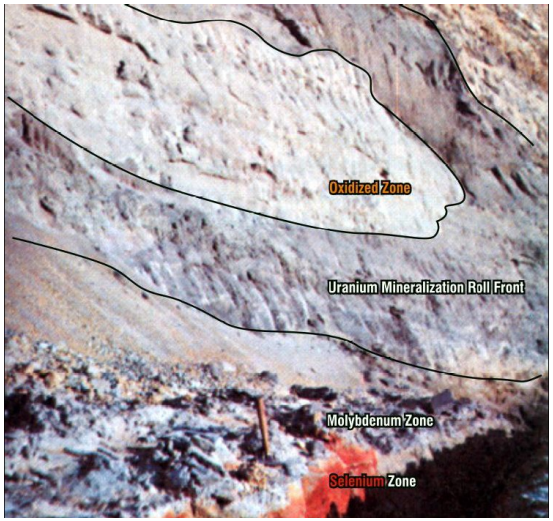
rise, causing increased costs to the consumer.

Uranium Imports

Over the past 40 years, uranium typically has been imported[29] from countries such as Russia,[63] China,[64] Uzbekistan,[65] Kazakhstan,[66] Niger,[67] Namibia,[68]etc., but efforts are currently underway to produce more of the fuel locally for utilities from more secure sources, such as in the U.S. and if necessary, from Canada[69] and Australia,[70] Campbell said. Just after the Soviet Union[9] fell apart, the Russian Federation arranged a deal with the U.S. in the 1990s to sell us uranium from their old nuclear warheads.[10] Bomb-grade uranium was dismantled from thousands of Russian nuclear warheads and was recycled into low-enriched uranium used to produce fuel for American nuclear power plants.

As Putin came to power, however, the U.S.-Russian relations soon deteriorated, and the *Megatons-to-Megawatts program* was not renewed in 2013.[10] About 70 million pounds (34,000 tons) of uranium are needed each year to fuel U.S. reactors. The federal government is making an effort to set up a Strategic Reserve of Uranium Fuel[46] to off-set imports of uranium to secure uranium supplies for utilities and, by doing so, support the American uranium mining industry in developing the numerous uranium deposits that are present in the U.S.

The reason the American utilities have chosen overseas sources of uranium in the past is because the uranium could be obtained at a lower price than that produced by American uranium mining companies.[20] Why? Because some of the countries produce uranium by their governments underwriting the costs of production with direct and indirect financial support, allowing them to produce cheap uranium, relative to American uranium mines. If this sounds familiar, it should because China is doing something similar in rare-earth metals, although the U.S. federal government has also taken steps to increase mining and processing of rare earths in the U.S. to meet strategic and industrial requirements.[38] But the U.S. has abundant sources of uranium in so-called roll-front deposits[26] capable of being recovered by in-situ mining methods in the U.S. mainland and in hard-rock deposits mined by open-pit methods, especially in Alaska and Virginia. For example, the Bokan Mountain deposit[37] is located near the southern tip of Prince of Wales Island approximately 60 miles southwest of Ketchikan, southeastern Alaska. The Bokan Mountain Granite complex is a Jurassic peralkaline intrusion composed mainly of arfvedsonite and aegerine granites that are host to more than a dozen identified uranium, thorium, and



Roll-Front Uranium Deposit – Old Open Pit Mine in South Texas

REE deposits and occurrences. Related ores occur in syenite and NW-trending sets of structurally controlled felsic vein-dikes, which are related to the granite complex and contain significant REE[38].

Other significant deposits occur in the Kachauik area and in the Death Valley area of the Eastern Seward Peninsula of Alaska.[54] The major zone of mineralization examined appears to be related to prominent phonolite dikes that occur along the margin of Cretaceous monzonitic country rock. Metasomatic introduction of uranium, thorium, and rare earths related to dike intrusion is postulated as the mechanism of metallogenesis. Areas with associated faulting and favorable host rocks, e.g., contact metamorphosed rock within fractured carbonate and graphitic rocks, as well as other favorable rock types, occur in the immediate area. There will be other such hard-rock deposits discovered in Alaska as well as roll-front uranium deposits in Alaska[43] and in the lower 48-states, e.g., Texas,[40] Wyoming,[55] Utah,[56] Colorado,[57] South Dakota,[58] North Dakota,[59] and in hard-rocks, Virginia,[42] Washington,[60] etc. So, sufficient uranium will be available to fuel U.S. nuclear power plants well into the future.

Regarding the cost of electricity, Campbell indicated that "uranium fuel costs[30] represent only about 5 percent of the operating cost of nuclear plant generation of electricity (whereas fuel costs of power plants using natural gas are much higher). The volume of fuel needed is the principal difference in that one uranium fuel pellet contains the energy equivalent of about 17,000 cubic feet of natural gas. And nuclear power is climate friendly (almost zero emissions) and business friendly (creating thousands of high- paying jobs)," he added.

Nuclear Waste or Feedstock for Later?

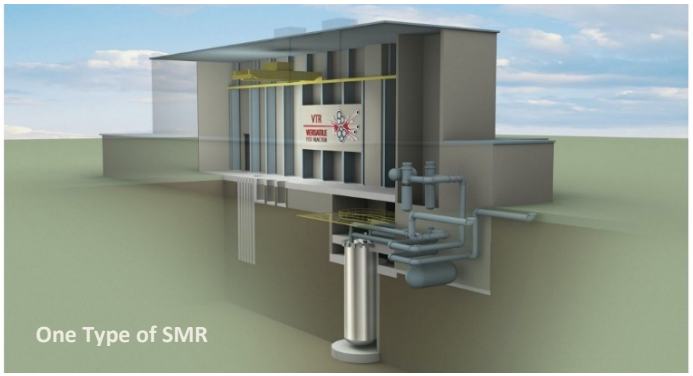
The matter of nuclear waste is a common point of contention by the anti-uranium mining and anti-nuclear groups. But they do not seem to recognize that the total amount of nuclear waste[45] produced by the United States since the 1950s – only about 83,000 metric tons – is small enough in volume to fit into an area of a football field 30-feet deep or in one *Walmart* with basements, Campbell said. The federal government was required by legislation in the 1980s to build a storage site, but some politicians in Nevada and Washington, DC obstructed, and a few geoscientists vetoed the completion of Yucca Mountain facility[31] in Nevada based on hydrogeological issues. Nuclear wastes are currently being held at plant sites in secure casks as temporary storage until the government manages the issue by constructing facilities for storing the nuclear waste for possible future use. Some wastes are also stored at the WIPP Nuclear Waste Repository in New Mexico.[36]

Subsidies Supporting All Energy Sources?

Under the Obama Administration, renewables received unrestrained support. This was manifested by significant tax incentives and subsidies[49] that grossly exceeded that of other climate-friendly energy sources, such as nuclear power.[35] Subsidies are still even higher for fossil fuels than climate-friendly nuclear power.[49] The unbridled enthusiasm for renewables has over the years evolved into the realization by many investigators that wind and solar have serious economic and other drawbacks.[24] The apparently "free energy" from wind and solar is more costly and less reliable in generating electricity than the other widely available climate-friendly energy source, nuclear power.

Beyond Hydrocarbons? … The Rest of the Story

Both renewables (with back-up batteries[48]) and nuclear power have their places in the energy plan. In areas away from the existing main power grids, such as in remote areas of the U.S., Alaska, and Africa, either wind or solar might have a role, but they will need back-up power in the form of expensive batteries. For pure climate-friendly grid-power,[35] nuclear power has no equal. As subsidies and basic economics[32] equilibrate over the years in favor of climate-friendly energy selections, a viable energy plan will come into focus that must be essentially nonpartisan. This need will become even more obvious when the small modular reactors (SMRs)[44] and new nuclear technologies emerge from the growing nuclear industry.[34] Even hydrogen is gaining attention for use in a variety of ways. It is interesting to note that nuclear power plants boil water as part of the designs of some of the plants. Only minor additions would be needed for them to not only produce electricity, but also hydrogen and oxygen as well.[72]


One Type of SMR

SMRs are Coming …

In the coming decade, Campbell predicts that the country and the rest of the world will begin to see Small Modular Reactors (SMRs) being constructed around the U.S. within and nearby cities, towns, neighborhoods, and in remote areas with the support of local, state, and federal governments. SMRs are small nuclear power plants that offer strong safety features,[50] lower capital costs, and will be reasonably priced to operate and require minimal waste handling by removing and replacing with new fuel in sealed containers built to be transported by truck or rail or dirigible. Eventually, SMRs are widely expected to replace many of the current wind and solar projects now operating and, in the future, will be installed and well-received in remote areas as well as in small towns and metropolitan neighborhoods because of their safe designs, their lower cost to construct, their lower cost to operate than natural gas facilities and natural gas distribution systems. The SMRs should initiate operations within the next 5 years.[44]

Fear of Radiation

Turning to an issue that is not related to science or technology, but to psychology. The fear of radiation[18] associated with nuclear power plant operations and its waste products continues to be at the core of a relatively small number of opponents to nuclear power and even to mining for uranium. Understandably, this fear originated at the end of WWII when the atomic bombs were dropped on Japan to end the war for the purpose saving hundreds of thousands of American soldiers' lives that would have otherwise had to invade a recalcitrantly fascist Japanese government. That is history we all will not forget and will remind the children of the future what and why it happened in the same way we must remind them of the Holocaust that was perpetrated by a Germany overcome by fascism.

But over the past 50 years, nuclear power has maintained an outstanding safety record. Mind you that no one has died or been irradiated as a serious injury in all these years of powerplant operations, with the exception of two nuclear incidents and one disaster. The latter, of course, was the 1986 Chernobyl[13] explosion, fires and radiation initially spread over a large area of the Soviet Union. A number of fire-fighters and associated personnel were killed and about 2,000 children were irradiated via consuming contaminated milk resulting in thyroid cancer; almost all were treated and cured, but a few children succumbed. The disaster happened only six years after the Three Mile Island incident (see below), and this compounded the fear of radiation. This time

people in the Soviet Union died and many were irradiated in the plant. But with some introspection over time, it was revealed that the Soviet Union[9] had insisted on using a dual-design nuclear reactor that produced electricity, but also plutonium for their nuclear devices. The safety controls were minimal. The West had been warning the Soviet Union about their dangerous design for years, but the pressures of the "Cold War" led to short cuts in order to compete with the U.S. and Allies, and to an ultimate disaster for the Soviet Union.[9]

Over the decades since, the International Atomic Energy Agency (IAEA) has reported that the radiation originally released, aside from irradiating safety workers and later indirectly the children as indicated above, has been absorbed and degraded in the forests and farm country more rapidly than originally expected. Further, a number of farmers living in the area also refused to leave when ordered to evacuate just after the initial explosion in the plant and as the resulting atmospheric plume of radiation spread over wide areas, including as far away as Finland, albeit at detectable, but harmless levels. All the studies conducted since on these farmers have indicated no health effects,[51] even of the very old who still live in the area and almost all of which smoked tobacco. This characteristic habit usually makes people more vulnerable to the effects of radon and radioactive isotopes in the air because they inhaled smoke deep into their lung tissues, which often causes cancers.

Many of the early uranium miners who worked in the underground mines in the 1950s of the western U.S., and who smoked tobacco, succumbed to such cancers at a much higher rate than non-smokers, but there is no record that the famers around Chernobyl developed an increase in such cancers, although many smoked tobacco. So, although abnormal radiation can be detected, it also degrades, and it apparently did not harm the farmers around Chernobyl. The miners in the U.S., however, were caught in a dangerous condition because we knew very little about radiation at the time, except for the fear of radiation induced by the Hollywood movies of the 1950s. Medical research has made the connection between smoking tobacco, radon gas, working in confined space (in mines), and resulting cancers. For years now, underground mines have had advanced air circulation systems to remove such dangerous gases and particulates as well (e.g., silica, carbon, etc.).

Media Impact on Nuclear Power

Regarding the incident at Three-Mile Island, in retrospect, this was a classic case of media fever that affected the local news, but then spread to the national news media, which exacerbated the fear in people's minds about the meltdown (a minor incident) that had occurred but came quickly under control by plant personnel. Little or very low levels of radiation had escaped, and no one was irradiated or was killed during the process of controlling the incident. Looking back now, this incident was successfully managed even with the rudimentary computers and technology, **but** the excessive media coverage[33] damaged the reputation of nuclear power that we are still dealing with even today in that people remember that time in 1979 in Pennsylvania.

The media and many of the people in the U.S. had just seen the Hollywood movie "The China Syndrome"[61] wherein stars Jane Fonda, Jack Lemmon, and Michael Douglas played characters (TV news media no less) that worried about irradiating all of California if their nuclear reactor melted down and about the melted fuel being so hot that it would melt its way down through the Earth and emerge at the surface in China, or so it went …. When Chernobyl occurred, that fixed the fear in many people's mind that nuclear power was too dangerous; since then, no new nuclear power plants were built in the U.S., until recently.

But then 25 years after 1986 came 2011, and the Japanese earthquake well offshore, followed by a tsunami of major impact. Aside from the thousands of deaths caused by the tsunami, it also flooded the Fukushima nuclear power plant and damaged the back-up power supplies for cooling fuel rods in storage at the plant. The uncovered fuel became over-heated and created hydrogen by boiling the water around it, which collected in the building. With a spark, combined with the excessive oxygen also produced, the hydrogen mixture ignited and blew the building apart, with the roof going straight up with a cloud of smoke. This sight, of course, was captured by the local news and was broadcast around the country and around the world only moments after it happened.[33]

Fukushima Power Plant (Before Tsunami)

With days of conflicting news reports about radiation that followed, the truth of the conditions at the plant settled into new reporting, which was, yes, some radiation escaped, but no workers at the plant or in the general area had been irradiated, and that the melted core was under control. In other words, they had managed the meltdown.

So-called experts opined on TV news about the possible damage to the surrounding area, but these claims turned out to be gross exaggerations within the world-wide news media once again contributing fear and apprehension about nuclear power. The possibility of such potential damages by a tsunami to the power plant had not been seriously considered. But management learned without deaths or without any one being irradiated. The surrounding area had been evacuated out of an abundance of caution, rightly so, but the fact that there was no widespread radiation was not emphasized by the news media for years after the incident. This created severe psychological damage in some local residents. Plus, experiencing the horrendous number of deaths and property damage caused by the tsunami along the Japanese coastline became mixed in with the fear of radiation, which was attributed to a few deaths of older Japanese, who likely recalled the fears and losses of family and friends experienced at the end of WWII.

A few years after the nuclear incident, almost all of the residents moved back to their homes, but a few refused to do so. These latent fears are understandable, but they are baseless nonetheless, now that we know that no one died and no one was irradiated during the Fukushima incident, contrary to impressions broadcast by most of the media coverage.[14] After the Fukushima incident, Japan began to turnoff all of their nuclear power plants for the purpose of examining the safety issues involved.[39] Years went by while they evaluated the issues. They turned to renewable and imported natural gas. Consumer electricity prices began to soar. They could not get sufficient power from renewables because of the land requirements needed, but also because the local weather did not cooperate in providing sufficient wind and sunny days. Soon, Japan began to apply new safety features to their power plants and by now many have returned to operation. Some plants have not returned for a variety of reasons, all geological or political. The latter impact is fading as the increase in electricity costs become apparent. Nuclear power has been and now is again their preferred source of power, with only minor reservations in some areas of Japan.

Germany witnessed the news coverage of the Fukushima incident also and promptly decided to depart from the previous nuclear power plant construction projects.[22] Since 1986, Germany had been operating 17 nuclear power plants. After Fukushima, Germany began to shutter their nuclear power plants, replacing the power requirements by burning more of their very dirty coal[28] (aka very high-ash content), building up renewables, and just recently began considering buying natural gas from Russia, all because they are not getting the power needed from wind and solar at a cost that was originally anticipated in the designs of those projects. Once again here is a case where the inherent flaws in renewables are resulting in increasing consumer electricity costs, and once again illustrating the value of nuclear power, but also highlighting the impact of an ill-informed German populace hoping for more wind and solar plants where the weather fails to cooperate. Some views in Germany suggest that Germany's younger voters (as in the U.S.) have naive views on what is needed, whereas the state economic advisors are being dominated by pro-renewable industry forces.

But other countries did not surrender to the fear of nuclear power as they did in the U.S., Germany, and for a while in Japan. France continued to build nuclear power plants, and, until recently received about 75% of their power from nuclear.[41] China and Russia too have decided to undertake new major nuclear power plant construction projects, and they have exported their capabilities to other countries as well to the Middle East, in Southeast Asia, and even in the United Kingdom.[20] Along with construction, both countries have offered to finance the entire projects, even with operation and maintenance guarantees.

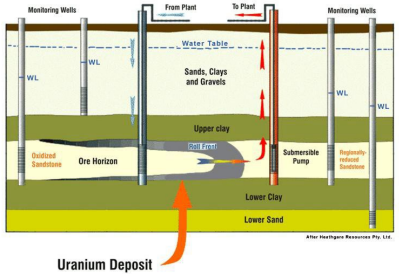
Offers of operation and maintenance services to some countries who showed an interest in having nuclear power to service their country presented a growing concern to some safety managers. The motivation of both China[19] and Russia[62] are not altruistic, but that of influence-spreading in the world of politics. What happens when country leaders do not please either China or Russia? They could just abandon the power plant leaving the country to provide such O&M on its own, an activity that country personnel might not have the capabilities to perform. Frantic calls to the U.S. and other developed countries for help in providing such services in their power plants might become necessary, if not immediately. In the meantime, it would serve these countries well to instead focus on developing renewable energy of wind and solar systems.

Nuclear Power is Ready to Step-Up ….

Finally, and until the state and federal governments assemble a rational climate-friendly energy policy, steps toward managing and minimizing the future impact on climate changes will be inhibited to the extent that our great-grandchildren may look back one day to our generation and either commend our actions or condemn our foolish ways. But as more of the media report on the overwhelmingly positive features of nuclear power, that too will have a positive impact on the general public to support nuclear power, if only to drive down the cost of consumer electricity and contribute to repairing the climate.

In the meantime, the uranium mining industry has the personnel and yellowcake processing plants on standby ready to resume production and expand exploration into old and new areas with discoveries that will provide hundreds of years of available uranium resources, as well as byproducts such as vanadium, molybdenum, selenium, rare earths, and thorium from a variety of secure sources, see [40,42,43,55,56,57,58,59,60,69,70]…. So, let the drilling and processing begin …

Production Drilling in South Texas



In-Situ Mining of Uranium

Yellowcake Processing Plant in South Texas

Note: References to the subjects discussed above are provided on nuclear power, natural gas, renewables, climate change, and related topics in the focused I2M Web Portal, which contains more than 10,000 records of current and historical papers, reports, and technical news items that have been selected by I2M management. Some records constitute internal reviews of the paper indicated with […]. To view references on specific subjects, search the database using one or more key words, with or without phrases with "…". The search results will provide a variety of perspectives on the subjects discussed above. Example: search result for "Nuclear Power Industry" and "Date" … meaning chronological listing of records. They will provide wide as well as specific coverage of the topics discussed. All search results are dynamic in that they are automatically updated as new records are added to the I2M database.

Selected Short-Cuts to General Topics:

1 EMD Uranium (Nuclear & REE) Committee 2020 Annual Report
2 AAPG EMD Uranium (Nuclear & REE) Committee
3 Three Mile Island
4 Fukushima
5 Nuclear Power - General
6 Renewables
7 Solar Energy
8 Radiation (General)
9 Soviet Union
10 Russia Megatons-to-Megawatts Program
21 Political Left
22 Germany
23 California
11 ACE 2020 Theme 9 Virtual Presentation (UCOM)
12 I2M Consulting, LLC, Seattle and Houston
13 Chernobyl
14 Nuclear and Other Bias
15 Climate Issues
16 Wind Energy
17 Wind Turbines
18 Fear of Radiation
19 China (Nuclear Power)
20 United Kingdom
42 Virginia Uranium
43 Alaska Uranium
44 SMRs (Small Modular Reactors)

24 Operation and Maintenance
25 Natural Gas
26 Roll-Front Uranium
27 Coal
28 Lignite and Brown Coal
29 Uranium Imports
30 Fuel Costs
31 Yucca Mountain Facility, Nevada
32 Economics
33 Media (Damage to Nuclear Power)
34 Nuclear Power Reactors
35 Climate Friendly
36 WIPP Nuclear Waste Repository, New Mexico
37 Bokan Mountain Uranium & REE
38 Rare Earth Elements
39 Japan
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41 France
45 Nuclear Waste
46 Section 232 Uranium Protection
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61 The China Syndrome
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New: See the World Nuclear News article.

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