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Security and Emergency response for a remote distributed reactor fleet in Canada's far north.

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ABSTRACT – The far north has become an area of great interest to SMR developers in the last several years. Remote and isolated communities with some small exceptions have not been the traditional territory for nuclear reactors. The technology however has now reached the point where their deployment in some of these non-traditional areas can now be considered possible. We do need to ask what would be the challenges of providing security and emergency support in these regions, and how could it be done effectively and cost efficiently?

1. Introduction

Small reactor technology is now being given real consideration for remote northern locations such as Military bases, mine sites, and civil habitations. How will security and emergency service be provided in these locales? Who should pay for it, and how can it be made affordable?

While some of the technology for this consideration already exists, it may exist in other jurisdictions. This creates many other issues regarding export controls, and depending on operational partners there may be issues regarding national sovereignty, air defence zones, and the martial applications of existing commercial technology.

In terms of the direct issues, we will discuss how to satisfy a regulator that Security and Emergency responses can be carried out in both an effective and timely manner. We will discuss the relationship between the fleet operator, and areas of public responsibility. It should also be noted that while in many cases it is assumed there is a government responsibility to respond to cases of serious criminal acts such as terrorism. This capability may simply not exist in these far northern and isolated locales. Effectively two mounties and a snowmobile 1000 kilometers distant, is not a credible response to terrorists attempting to steal or sabotage one of these proposed nuclear units.

2. Geography

Due to the distances involved between the remote operating sites there will have to be either multiple regional support sites, or some sort of central response center.

For the purposes of this talk the Port of Churchill, Manitoba is proposed for the purposes of a central response center.. Churchill is extremely central to Canada. On a great circle route it is 2966 kilometers to St.Johns, Newfoundland. It is also a distance of 2825 kilometers to Anchorage, Alaska, and 2809 Kilometers to Canadian Forces Station Alert. For reference it is only 3849 kilometers from Churchill, Manitoba to the Geographic North Pole.

Using Churchill allows access to the pole by most business jets, and legacy airliners. This arc also covers nearly all of the North American land mass. Including Greenland, parts of Iceland and possibly portions of the northern European islands and Russian territory. For reference a modern business jet, or a legacy Boeing 727 could cover this territory well inside of four hours flying time. This would allow a response well within 3 hours in almost all cases. More importantly the Churchill Airport has a very large asphalt runway which it reports can accept Boeing 747's, and Airbus A380 aircraft.

Churchill also offers an office of the Canadian Space Agency. While this itself may not seem important the site also offers Canada's only licensed rocket range for extreme altitude (orbital) launches of heavy rockets. Additionally Churchill possess one of Canada's most northern all weather rail lines which features access to the North American rail network. It also possess an electrical transmission connection to the remainder of the North American electric grid. Thus providing reliable and inexpensive electricity supply at this northern locale.

Finally Churchill possesses a seasonal shipping port. This port is capable of accepting ships of 225 meters length on axis, and 11.5 meters in draft. This permits container, and shipping vessels of all but the largest sizes to operate from the Port. Given the rail line and shipping access, these alone provide a massive benefit to any distributed fleet operator considering the far north.

3. Security and Emergency preparedness at each site

Each site will require that the reactor maintain a hardened access containment structure to prevent unauthorized entry. The design requirements in this case will be somewhat different for any given reactor technology. The overall goal of the hardened access design would be to provide emergency mitigation, and containment of fission products, while delaying interlopers from accessing nuclear materials for as long as reasonably possible.

Consideration will have to be given to how long it would take interlopers to gain access to such a site given planning and access to tools which could reasonably be found at, or brought to any given site. Thereon, planning to deter, delay, or neutralize such parties will have to be undertaken. This planning obviously would seem to require a security system, datalink, and real time monitoring system. In the case of normal operations this would be likely be expected to occur through commercial satellite uplink. For the safety of the reactor, a reciprocal keep alive signal would also be expected. The loss of such a signal after a given period of time would be expected to shut down the reactor to a safe state.

In addition to the automated security system it should be expected that some local individual would be tasked with monitoring the site and reporting unusual conditions. A verbal report of unusual goings on would also cause an initial security response.

In terms of an automated security system, there will have to be consideration given to such things as non-lethal automated responses possibly in the range of chemical irritants, electrical shocks, and even possibly directed kinetic energy devices such as bean bag launchers, or other such devices.

Up to this point we have been considering a relatively passive security plan. One in which our presently fictitious nuclear plants are protected by what is effectively an alarm system and a locked door. Upon any disturbance the operator would simply call the police. Which would in most of the cases considered be the Royal Canadian Mounted Police.

4. Providing a timely outside security response to each site

The RCMP are Canada's federal police force. They are also the local municipal police throughout the northern Canadian territories. Regardless in almost all cases the RCMP would form the core of almost any initial response. It should be noted that the RCMP presence in most northern communities is simply two officers. In some places there is no permanent presence with the RCMP attending on regular patrols every couple of weeks, and for emergencies by charter aircraft. In the cases of the small nuclear power plants in every community in the far north, it would be considered important to attend every security alarm as an emergency. This however could get very expensive to the public purse, and possibly place the force in a position where they could credibly argue the operators need to provide their own initial response. At least to verify the alarm is credible.

If the operator were placed in a position where they had to determine if every alarm was credible it would create a great deal of added complexity, and thus cost. Even with a local representative, and remote monitoring from a central control center it may be impossible in some cases to guarantee an alarm to be false, or possibly dangerous to verify it is an actual security situation. It would not be considered wise to the have the local representative simply drive to the plant site if there was a group of armed criminals present. Consequently two mounties on snowmobiles may not be able to do anything about an organized group of criminals at the reactor site.

It should be stated at this point that in reality the main purpose of any initial security response would be primarily to prevent the criminals from leaving the site with any nuclear materials. To this end the operator would need to provide monitoring of the situation and possible interventions to delay the criminal operations.

To this point the use of Unmanned Aerial Vehicles is considered to be a cost effective, and safer means to verify the condition of any site. Further a small remotely operated aerial vehicle could not only observe the criminal operation, it could if need be used to ram an aircraft and disable it while parked on the ground.

In almost all cases the UAV's would be installed at the reactor, and would self launch on security alerts. It would be expected that such UAV's would be monitored from a central operations center. This would allow a fleet operator to instantly have a presence over the area of a small reactor installation. This presence would also be beneficial in the case of emergent situations, and environmental situations.

It should be noted that there are many examples of UAV's now being armed and used remotely in combat situations. There is even a drone called a K-Max which is now used without a pilot to resupply American troops in Afghanistan. The arming of the drones is one consideration,

however this would be considered extreme, and in reality could only be considered in cases where a very immediate security response would be required, or an ability to immediately interfere with a criminal event would be demanded.

In such cases it should also be pointed out that each site may not require it's own armed drone. The port of Churchill's rocket range now comes into further value. A Canadian Aerospace company called Magellan Aerospace manufactures a rocket called a “Black Brant”. This is normally a high altitude sounding rocket, or a high altitude research rocket. Some variants are able to reach altitudes of 1500 kilometers. This is higher than the international space station’s orbit. Additionally they can carry payloads from 100 kilograms, to 850 kilograms. Using Churchill's rocket range (which is already equipped to launch the Black Brant), and it’s central location this may enable the operator’s security element to place an armed UAV anywhere in North America in well under 30 minutes. This is not a small capability.

It should also be noted that it is not an unusual occurrence for the RCMP to gather an emergency response unit of several officers or more to deal with a situation in an isolated community. However they still rely on air transport. It would still be difficult to locate enough officers in a timely fashion, and to deal with an organized criminal element. This operating in a remote community may take several hours, or possibly even days.

Even in the case of clear terrorist operations, it would not be realistic to expect a response by the Canadian forces inside of 24 hours to reach one of these locations. Given that many of these locations possess a single runway, it would not be hard for this criminal group to block the runway, or import a use of force option that would be effective against a charter aircraft or an airliner attempting to land at the only runway in an area of possibly 1000 kilometers.

It may be expected that the operator would have to provide a security force capable of dealing with an armed threat. This is presently the case in most of Canada's existing nuclear power plants. Bruce Power's security force for instance operates armoured vehicles, and possesses automatic weapons. In this case the small output of each of the reactor sites could not justify their own security forces. They would have to deploy from another location to provide coverage for a larger number of reactor sites. Thus It becomes an issue of affordability, and practicality.

While there are many airliners in existence that would satisfy the need to carry equipment and specialists, it should be noted that very few airliners have a rear loading ramp that can be opened in flight. One of the only airliners with this particular ability is the Boeing 727. Another interesting characteristic of the 727 is that it is arguably one of the fastest airliners ever built. It was also operated in the far north by First Air for two decades. The 727 while not inexpensive to operate is fast, durable, able to operate from gravel strips, common, and can deploy personnel and small cargo items in flight. Such an aircraft can remain loaded with gear sufficient to respond to most emergencies, and security incidents and arrive anywhere in North America inside of four hours. Further it can deploy a security force without having to land. In the case of a real emergency the fuel economy of a legacy airliner would cease to be an issue.

5. Dealing with conventional emergencies at remote SMR sites

With the recent addition of Fukushima as the primary example of the worst case scenario involving any reactor site. It has now become apparent that immediately after any reactor catastrophe there are always pieces of equipment and materiel that the initial responder require.

This may include emergency electrical generators, diesel fuel, radiation instruments, neutron absorbent materials, and even the simplest materials such as drinking water for emergency crews. Simply being able to arrive at a site with portable emergency generators in the multi megawatt scale could alone prevent a disaster. Commercially there are examples of 20MWe generators that fit inside of standard shipping containers. If such a generators could arrive in the first four hours or less of an incident then the incident may cease to evolve into a disaster.

Effectively the use of a legacy airliner with a cargo door modification allows for the very rapid deployment of supplies and equipment to reactor sites. This capability would also be of great value to the existing site operators. Examining the lessons of Fukushima, and Chernobyl would provide fundamental knowledge in what materials to bring initially to any emergent situation developing at a commercial nuclear site.

6. Conclusions

While the idea of a private operator owning a rocket deployment capability similar to an ICBM, UAV's, and private air deployed armed security forces may seem somewhat of a stretch. It should be noted this is being provided through geographic placement, and off the shelf existing technology in all cases. While this would require the security officers to reside near the aircraft during their duty periods it would not require the officers to live in Churchill. Additionally the security officer's don't have to belong to the operator, and neither do the UAV's. It should be noted that the Canadian forces cannot at present put an armed UAV over the North Pole in 30 minutes. Nor can they drop a team of soldiers anywhere in North America's far north inside of four hours. At present a Canadian fighter jet still requires several hours of flying time to intercept a Russian bomber over the pole. In much the same way none of the existing Canadian nuclear sites could likely place an armed aerial presence over their existing sites in 30 minutes. There are possibilities for multiple partnerships in this case.

It should be noted that this is not a research paper in the conventional sense but a discussion item. There is no definitive conclusion per se. It should be considered as a means to put the question to the audience, “How do you deal with security and emergency response at unattended reactor sites, in the realities of Canada’s far north”?

7. About the speaker

The Author Jay Harris, is a Canadian Aboriginal. He has completed a three year commercial electronics diploma. Served as a journeyman aircraft maintainer in the Canadian Forces. Then enlisted in the Royal Canadian Mounted Police. Jay spent most of his five year RCMP career in isolated locations, and in 2001 led the most Northern Police investigation in Canadian history to the Northern Polar ice cap. Jay Harris is now employed as a Nuclear Operator at a Candu generating station in Ontario, and has entrepreneurial aspirations for the future.

Jay routinely gives talks about Small Modular Reactors, and routinely gives his very popular talk "Nuclear North of 60" in many locations and countries.

8. References and Credits (In no particular order)

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Omnitrax International, (Port of Churchill); http://www.portofchurchill.ca/; Manitoba

Great Circle Mapper, www.gcmap.com

Airliners.net; www.airliners.net; (Boeing 727 Data, history, modifications)

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Canadian Department of National Defence; www.forces.gc.ca; (Photo's, location data, capabilities, history, responsibilities)

Royal Canadian Mounted Police; www.rcmp-grc.gc.ca; and www.wikipedia.org; (History, responsibilities, capabilities, the Toronto 18)

Bruce Power; www.brucepower.com; (Security at Canadian nuclear sites example)

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World Association of Nuclear Operators; www.wano.info; (Emergency response model partially based on earlier submission for a global nuclear response program submitted by the author while at the World Nuclear University in 2011).

Wold Nuclear University; http://www.world-nuclear-university.org/; (Various lectures by various speakers on the incidents at both Fukushima and Chernobyl, context, reality, political implications)