Nuclear powerplant: as main souce of energy essay

Business, Industries

Nuclear Powerplant: As Main Souce of EnergyIntroduction: It is matter which gives us shape and energy whcih gives us the action and they both together make this beautiful creation. The best possible marriage of matter and energy is celebrated as life in the creation; while the seperation of the two stands out as the best definition of death.

There is plenty of matter around so is plenty of energy; but not all the form of matter is useful to humanity and so is the case with energy. Humans need matter in a variety of specific from like as metal, alloys, composite etc. and they like energy is a variety of specified forms like electricity, chemically stored energy, kinectic energy, heat etc. That they are not different but just different menifestations of each other was derived beautifully by the genius of the 20th century, I will prefer to say the genius of all times, Albert Eistein, through his Special Theory of Relativity. His famous formula, E = mc2, puts matter (m) and energy (E) on the two sides of an equal sign, through a universal constant, the velocity of light in vacuum (c) squared. Here we will not get into the “ Special Theory of Relativity” or the derivation of this formula, which is now part of syllabus of college physics and readers are advised to refer to any good book on Modern Physics to undersrstand and enjoy the beautiful theory by Albert Einstein. With this energy – mass equivalence formula, the world came to know a perpetual source of energy, the matter, which is avilable in such an abundance that there can be no energy crisis.

But whether the picture is so beautiful, not really as world has to face the Middle – East energy crisis even after many decades of this formula being known and many power plants operating on the principals of this magical formula. The catch is, one needs to destroy the matter to convert it into energy and to destroy the matter to convert it into energy is no childs play. Even after this formula was known, it took many years to realize that to some extent matter can be destroyed in nuclear fission and nuclear fusion reactions and also that these reactions can be self sustaining in some nuclear reaction systems. It will be appropriate to have a look at historical developments in this field. It will not be inappropriate to start on an apologetic note that the first use of this fantastic source of energy was for destructive purpose – Bombing of Japan in 1945 during the World War – II.

So tragic were the consequences that nobody can look for any justifications, whatever could have been the stratagic compulsions of the war. One can only hide himself behind some pretexts of strategic compusions coupled with the fact that the enormity of the effects of bombing were beyond imaginations of even those who made it and those who ordered it. The team of Otto Hann and coworkers, while bombarding uranium with neutrons, realized that nuclear fission is the way to unlock the energy concentrated in the form of matter. Subsequently Enarigo Fermi and coworkers proposed that there must be a system which will produce neutrons during the fission reaction to sustain the fission chain reaction and this system was found to be U235 nucleus.

The team led by Enarigo Fermi constructed the first nuclear reactor, which went critical in 1942, in USA. Subsequently, many reactors were constructed to breed Pu239 another fissile nucleus to for making the infamous atom bomb to be used in World War II. We will revert to some of the scientific details later in this essay. Though, bombing of Japan durin World War II remains the dark spot on the face of the remarkably beautiful Nuclear energy, very soon after the World War II the good wills, which is the underlying theme of humanity prevailed upon the evil designs, always ready to retard the pace of progress, when in December 1953, President Eisenhower announced the “ Atoms fro Peace Program”; a program to make available the benefits of the peaceful uses of nuclear energy to all nations. With this there was a new begining and the immense potential of the nuclear energy was there, ready to be grabbed by humanity. Since the nuclear power has made great strides and today approximately 20% of total electrical energy consuption of US is supplied by nuclear power plants. For many countries like france this happens to be as high as 80% of total electrical energy consumption. Besides, this industry plays a great role in the US economy by the way of exports of Nuclear reactors, instrumentations, fuels, materials, know how etc.

and has a great potential as many developing nations with large demography like Inida, China, Pakistan etc. are planning to expand their nuclear power production in a big way. In subsequent sections we will examine the technical aspects like different reactor systems, different components for nuclear power production, Statistics in terms of power production, number of nuclear power plant etc. and finally we will discuss the case as to why nuclear power should be the main source of power for USA. Technical Aspects of Nuclear Energy: Besides, the basic science of E = mc2, a lot more of basic science and much more of sophisticated technology is involved in production of Nuclear Power. By nuclear power I mean, the electrical energy produced by rotating the turbine using the steam produced from the heat generated in a reactor due to fission reactions.

The turbine is much like the conventional power plant, but the reacor is altogether different. A nuclear reactor is the heart of a nuclear power plant and therefore, it is necessary to concenrate on the nuclear reactor. Nuclear ReactorA nuclear reactor, is a containment for controlled nuclear fission chain reaction, which releases enormous energy according to the mass – energy equivalence relation. Besides, there are many other useful as well as undesirable reactions. There are arrangements to keep the chain reaction under control as well as to ramp up and down the power of the reactor.

There are arrangements to extract the enormous amount of heat being produced in the reactor, bu using suitable coolants, which run in close loop and extract the thermal energy out of the reactor system, which is subsequently exploited for electricity production using a turbine. So intricate, but beautiful is a nuclear reactor, that it will be unjust not to discuss it in somewhat detail. We will begin that by discussing the different components of a nuclear reactor before discussion different nuclear reactors. FuelWhat fuels a nuclear reactor.

It is the controlled chain reaction of fission of a fissile nuleus by neutrons. So what is a fissile material. A nuleus, which is broken in two halves when bombarded by neutron and releases a few neutrons to sustain the fission chain reaction, will qualify as a fissile material. The major component of energy (~80%) relaeased during fission reaction is shared by these two halves of the parent nucleus, the new fragments are termed a fission fragments.

Rest 20% is carried by g rays and fast neutrons. Depending on whether the fission reaction was effected by fast or slow or thermal neutron, we have Thermal Reactors or Fast Reactors. Thermal reactors are the backbone of nuclear power production today, however, the fast reactors are looked upon as the vehicle of nuclear energy tommorrow. Coming to the fuel, there is only one naturally ocurring fissile nucleus U235. this is one isotope of uranium and its natural ocurrance is just 0. 7%, remaining is U238.

This concentration is not good from the criticallity point of view, except when heavy water is used as moderator as well as coolant. This is used as fuel in Pressurized Heavy Water Reactors (PHWR); pioneered by Canada and is predominant in Canada and the countries like Inida, which received these reactors from Canada; in the form of oxides. Besides, there are two artificial fissile nuclides Pu239 and U233. These are syntesized in nuclear reactors, when a fast neutron produced during fission reaction is captured by a fertile nucleus. A fertile nucleus is one which gets converted into a fissile nucleus, when it captures a neutron. Thus fertile materials are potential fuels.

The fertile materials for synthesis of Pu239 is U238 and that for U233 is Th232. It will be relevant to discuss the ocurrance and market of Uranium the fuel of all nuclaer reactors: Uranium: It is the fuel of present days nulcear power reactors. It is a metallic element.

It has silvery luster. It is 92nd element in the periodic table. It is an actinide and it is the last naturally ocurring element on this planet. It has three isotopes – U238 (92. 28%), U235(0.

72%) and U234 (0. 005%). It occurs in very samll concentration in the Earth's crust and it occurs in the form of oxide – Uranite, pitch blend etc. It is slightly radioactive and decays by a-emission. Half life of U238 is approximately 4.

5×107 years. Of the three isotopes U238, U235 and U234; only U235 is fissile and is useful as nuclear fuel, however U238 is fertile material and is useful as breeding material for the other fissile material Pu239, which is very useful as nuclear reactor fuel as well as for making nuclear weapon. The estimated researve of uranium in the form of uranium ore is about 4. 7 million tons. Besides, there are mineral deposits to the tunes of 35 million tons, extraction of uranium from which is expected to become economical in days to come (Global Uranium Resources 2006). Not only this a lot more about 4. 6 billion tonnes of uranium are estimated to be in sea water and with advancement in technology coupled with increased demand on uranium for energy production, one can think positively that extraction of uranium from sea water will become economically aminable in days to come (Uranium Recovery from Sea Water 1999) and (How Long will Nuclear Energy Last 1996). Due to increased demand of uranium for energy production, now fresh capital expenditure is being directed for uranium exploration.

In 2005 as much as US$200 million was spent for uranium exploration. This figure is ~54% higher than that of last years figure (Global Uranium

Resources 2006). Now coming back to global researves and productions – Australia has the largest uranium ore deposit in the world (38%) (Australian Uranium and Who Buys It 2007). The single largest uranium deposit on the earth is located at the Olympic Dam Mine in South Australia (Uranium Mining and Processing in South Africa 2002). Looking at the production of uranium in 2005, as much as 94% of uranium oxide production was concentrated in 10 countries. table 1 gives % of uranium oxide production in 2005 in top ten producing countriesTable 1: Uranium Production in 2005 (World Uranium Production 2006).

Sl. No. Country% of worlds total Uranium oxide production1Canada27. 92Australia22.

83Kazakhastan10. 54Russia85Namibia7. 56Niger7. 47Uzbekistan5. 58USA2. 59Ukraine1.

910China1. 7It is very clear from the table 1 that Canada (27. 9%) produced the maxiumum uranium oxide in 2005, followed by Australia (22. 8%) and Kazakhistan (10. 5%).

USA produced approximately 2. 5% of total global uranium oxide production in 2005. In USA the uranium researves are located mainly in Colorado, Utah, new Maxico and Arizona. Because, the largest uranium producer are not the largest nuclear power producers, therefore, there is an international market of nuclear fuels – uranium oxide as well as enriched uranium. The countries engaged in uranium international market constitute Nuclear Suppliers Group (NSG) and the international trade of uranium is carried out under strict safeguards of International Atomic Energy Agency (IAEA) to ensure that none of the uranium is utilized for nuclear weapon making.

Though the presently known researves of uranium is arge enough to keep the reactors running for about 100 years, there may be demand supply mismatch due to the fact that many devloping countries with huge demgraphy like India nad China are planning to go for nuclear energy in a big way to reduce their over dependence on oil, price of which is rising like anything and supply of which has lot of uncertainty associated with it due to geopolitical reasons. This huge expansion in nuclear power program of countries like India and china will put lot of load on supply side, which may not be able to cope up with the rising demand due to he fact that there was lot of under investment in Uranium mining in past couple of decades. ThoriumThough, thorium is not the present day fuel of nuclear reactor, it is the potential fuel material.

It is actually a fertile material from which another fissile material U233 can be bred in fast reactors and then this U233 can be used as fuel. Now some nuclear organisations like Bhabha Atomic Research Center (BARC), the institution spearheading the Indian Nuclaer Program (civilian as well as millitary) are working on reactors for even thermal breeding of Thorium. The reactor is named Advanced Heavy Water Reactor (AHWR), which is on a design level and has a design life of 100 years. In days to come, there may be constraint on uranium supply either due to depletion of researves or due to some other political reasons and then a nuclear power plant operating on thorium will be of great strategic importance.

Therefore, it is iportant to briefly discuss thorium here. Thorium is a metallic element. Its atomic number is 90 and its most abundant isotope is Th232. In nuclear reactors, it absorbs a neutron and emits two b particles and thus gets converted into U233. The conversion reaction or breeding reaction is much like that from U238 to Pu239. The primary source of thorium is monazite, which is a phosphate mineral.

It contains ~12% thorium oxide or thoria. Thorium is mildly radioactive, it belongs to 4n series of radioactive elements. It has a half life which is three times close to thrice the age of our palnet. Now we will look at the reserves of thorium across the globe.

It should be mentioned here that knowledge of thorium reserves is not very good, mainly because, it is not in much attraction or much demand as of today. This is the reason that the estimates by different agencies vary to considerable extent. US Geological Survey, Mineral Commodity Summaries (1997-2006)(US Geological Survey, Mineral Commodities Summaries – Thorium 2006) and (Information and Issue Briefs – Thorium 2005), presents following estimates of the economically available thorium reserves. In case of thorium as well, Australia is leading, but the second position is commanded by India, which has as much as 25% of the world’s Thorium reserves (US approves Indian Nuclear Deal 2006). Therefore, it is not surprizing that Inida is putiing so much emphasis on Thorium based fast breeder reactors (FBTR, PFBR etc.

) as well as thermal breeder reactors like the proposed AHWR in its ambitious nuclear energy program. Table 2 presents global thermal reserves from US Geological Survey, Mineral Commodities SummariesTable 2: US Geological Survey, Mineral Commodity Summaries (1997-2006) (US Geological Survey, Mineral Commodities Summaries – Thorium 2006) and (Information and Issue Briefs – Thorium 2005)Sl. No. CountryTh Reserves (tons)Th Reserve Base (tons)1. Australia300, 000340, 0002. India290, 000300, 0003.

Norway170, 000180, 0004. United States160, 000300, 0005. Canada100, 000100, 0006. South Africa35, 00039, 0007..

Brazil16, 00018, 0008Malaysia4, 5004, 5009. Other Countries95, 000100, 00010. World Total1, 200, 0001, 400, 000There is another estimate on global thorium reserves of Reasonably Assured Reserves (RAR) and Estimated Additional Reserves (RAR) of thorium by OECD/NEA, Nuclear Energy, " Trends in Nuclear Fuel Cycle", Paris, France (2001) (Information and Issue Briefs – Thorium 2005), which is presented in table 3, below: Table 3: Estimate of global thorium reserves from OECD/NEA, Nuclear Energy, " Trends in Nuclear Fuel Cycle", Paris, France (2001) (Information and Issue Briefs – Thorium 2005): Sl. No.

CountryReasonable Assured Reserves Th (tonnes)Estimated Additional Reserves Th (tonnes)1. Brazil606, 000700, 0002. Turkey380, 000500, 0003. India319, 000-4. United States137, 000295, 0005.

Norway132, 000132, 0006. Greenland54, 00032, 0007. Canada45, 000128, 0008. Australia19, 000-9. South Africa18, 000-10. Egypt15, 000309, 00011.

Other Countries505, 000-12. World Total2, 230, 0002, 130, 000The two tables on global Thorium reserves vary considerably specially for Australia, Brazil and Turkey. This is because of lack of interest in thorium as of now. However, the estimates for India remains more or less same.

This is because, India has carried out detailed survey of its thorium reserves as it forms an important stage in Inidan nuclear program and India knows significance of its vast thorium reserves. ModeratorIn a nuclear reactor, moderator is an important component. What moderator does is that it slows down or moderates (the kinetic energy or speed) the fast neutrons produced during fission reactions. It should be mentioned here that neutrons liberated during fisiion reaction are having very high kinetic energy of the order of a few MeV.

Only a few will contribute to the chain reactions as probability of fission reaction with fast neutrons is much less and the most of them will escape the reactor as lekage rate of neutrons is much higher at higher velocities. Therefore, moderation or slowing down to reactor temperatures is a must for operating the reactor with natural or low enrichment fuels. However, for fast reactors moderators are not required as fast neutrons are better for breeding and at the same time the count of fission reaction is increased by increasing the enrichment level of the fuel. Moderation is effected by collision of fast neutrons with light nucleus like hydrogen, deuterium, carbon etc. at reactor temperature. The physics of collision is such that a light nucleus will very effective for moderation, while the heavy nucleus will not be effective at all. Because of this reason water, heavy water, graphite etc.

is used as moderator in a nuclear reactor. Because, water absorbs lot of neutrons and therefore, suitable with enriched fuel only. Heavy water on the other hand absorbs very less of neutrons and is therefore, very very suitable with natural uranium fuel. This is the reason, why reactors moderated by heavy water form the backbone of nuclear power program of nations having low or no access to the enriched fuels.

CoolantBecause lot of thermal energy is produced in reactor core by fission reactions, therefore, it is a must to extract the heat from the reactor core for the reactor safety point of view as well as to utilize the thermal energy for electricity production. The coolants vary from reactor to reactor, however, the main coolants are light water, heavy water, liquid metal, CO2 gas etc. Control RodsControl Rods are made of materials having very high neutron absorption capabilities like boron, Hf, Cd, Gd etc. These are required to regulate the thermal power of the reactor and also very important from reactor safety considerations. These rods are kept inside in a reactor in a lowered condition. As their level is raised, additional reactivity is released in the reactor, the power of which increases. To reduce power or to shut down the reactor, their level is again lowered. Pressure VesselThis is the containment for the reacor core comprising of the fuel, moderator and control rod.

It is made up of Stainless Steel of Grade SS 304L. The concept of pressure vessel is valid with enriched fuels, which has a compact core. In reactors like PHWR, where due to natural fuel and heavy water moderator, the size of core is bigger and it is not feasible to fabricate pressure vessel of that size.

Therefore, there a normal vessel is used instead and pressure tube made of zircaloy is used. Zircaloy is thus essential for PHWR program because of its low neutron absoption properties.

Besides, there are many sub systems in the nuclear reactor, which is not important to discuss here. Now we will briefly discuss, the different type of nuclear reactors. Different Nuclear Reactors1.

Boiling Water Reactor (BWR)In Boiling water reactors, enriched uranium fuel is used. The coolant and the moderator is light water. The coolant is allowed to boil in the reactor. The stam is used to run a turbine, which produces electricity. It is worth mentioning here that boiling water reactors require enriched fuel and therefore, are suitable only for those countries which have access to the enriched uranium.

These reacotrs are simple in design and inherently safe from the reactors point of view. They have higher conversion efficiency of thermal energy to electrical energy. However, the boiling water puts lot of demand on the reactor construction material and there are more chances of activity spill over, because there is just one loop of coolant, which gets active and comes in contact with different parts like turbine. Thye reactors cannot be fueled online and therefore, shutdown is required for refuelling of these reactors. 2.

Pressurized Water Reactor (PWR)In these reactors, water is used as coolant as well as moderator. The fuel is again enriched uranium. However, water is kept at much higher pressure to allow boiling at reactor temperature.

The coolant flows as liqiud in a closed loop at high pressure, extracting the heat from within the reactor core. Outside the core, there exists another secondary loop of water-steam at lower pressure, which extracts heat from the primary coolant loop and boils. This steam is used to run a turbine to produce electricity.

Because, there is one extra loop therefore, efficiency of the reactor to convert thermal energy into electrical energy is lower than that of a BWR. However, here chances of activity spill over is much less as the coolant loop is closed and also water has lower demand on the reactor materials than steam. 3.

Pressurized Heavy Water Reactor (PHWR)These reactors are of canadian origin and very popular in Canada as well as in developing nations like India, where access to enriched fuel is limited. This reactor runs on natural uranium oxide fuel contained in thin zircaloy cladding. The fuel pins (half meter long) are clusterd in a 19 pin or 37 pin bundles. Several of such fuel bundles lie in a pressure tube made of zircaloy and passes through these pressure tube or collant channels, high pressure heavy water in a closed loop. Large nuber of such pressure tubes are kept horizontally in a calendria tube made of SS 304L, which is a big reservoir of heavy water as moderator. The reactor is fuelled online and therefore a shutdown is not required for refuelling. The coolant is hevy water at high pressure to not allow boiling of the coolant at reactor temperatures. The heat extracted by high pressure heavy water coolant is exchanged with low pressure secondary water circuit.

Water in the secondary circuit boils and theis steam is used to run a turbine for producing electricity. As two coolant circuits are involved in conversion of thermal energy of a nuclear reactor into electrical energy, therefore, efficiency of PHWR is much lower than that of BWR. 4. Gas Cooled Reactor (GCR) and Advanced Gas Cooled Reactor (AGCR)In these reactors, moderator is graphite and the coolant is carbon dioxide gas. Such reactors are used mostly in united Kingdom.

Though, they have higher efficiency, they have large size and are falling out of favor now a days, due to large size of the core. 5. Fast Breeder ReactorsThese are high temperature reactors, without any moderator. These are particularly useful for breeding fissile materials from fertile materials. They produce more fuel than they consume, while producing the electrical power. They use lot of thorium. Thus they are the potential powers sourceds for future.

This is the main reason, why some countries like India has lot of emphasis on its fast breeder program. The coolant is liquid sodium, which has much higher boiling point compared to other coolants like water, heavy water etc. and therefore, there is no need of a pressure vessel to be used for containing the reactor core. Even lead or lead-bismuth eutectic can be used as coolant.

Such reactors are in nacent stage, but hold lot of potential for future generations. After having discussed the basic scientific and technological issues related to nuclear power production, we will discuss some statistics and status of global nuclear power production and position of USA in global nuclear power production. Table 4: Presents the global production of Nuclear power in 2005 and also number of reactors operating as well as planned for installation (Nuclear Power by Country 2007)CountryNumber ofreactorsPower outputMWConstructingPlanned or OrderedProposedWorld4423707212862160European Union14713026727United States of America10499209113France596336311Japan554759311Russia3121743418 United Kingdom2311852South Korea20168108Canada18125992Germany1720339India1635577420Ukraine 15131072Sweden108910People’s Republic of China1075725519Spain87446Belgium75824Taiwan648842Czech Republic633682Slovakia624422Switzerland53220Bulgaria427222Finland (details)4267611Hungary41755Brazil219011South Africa21842124Mexico213102Argentina29351Pakistan242512Lithuania1118 51Slovenia1656Romania1655121Netherlands1449Armenia13761Iran00123N orth Korea004Turkey003Indonesia004Vietnam002Egypt001Israel001Poland001Th e table presents a very important statistics. In simple terms one would say that while the Europian Union is leading the pack with 35% of global nuclear power production, the USA as a nation is leading the pack with 27% of total global production. While this part of statistics looks beautiful, there are other facts which are not so beautiful. In USA only 20% of total electricity production comes from nuclear power, rest comes from other conventional sources like coal, oil etc. In France, nuclear power supplies 80% of total electricity production and only 20% from other sources.

The other important statistics coming out of the table is that, the present number of operating reactors world wide is 442, producing 370 GW power. If we go by the number of reactors under construction and proposed, then number of nuclear ractors will rise by as much as 60% in next five years. Going by the number of reactors, the nuclear power production will also rise by at least 50% in next five years. But then the growth rate is not secular.

Just 10% growth is there in US numbers, then from which corner of world is coming the growth. It is coming from the developing countries like People Republic of China, India etc. These developing nations have big plans for nuclear power production. China has plans to grow by as much as 300% from 10 existing reactors to 40 in next five year. India is planning to go for 20 GW from current 3. 5GW by 2020. Though, the leadership position of USA will not be challanged in near future but going by the present trend, the same can not be said about 50 years from now.

It is therefore, pertinent to explore as why Nuclear Power should be our main source of energy. In subsequent sections we will discuss these issues in detail. Justifications for Nuclear Power being the main source of energy for USA. 1.

For secured energy future of the nation: Today USA relies on conventional exhaustable sources of energy for as much as 80% of total electricity consumption. The energy sources are coal, natural oil and gas etc. These resources will not last for ever. A reasonable estimate puts that we can relie on these sources for approximately 50 years. What about after that? May be some new resources will be discovered and another 20 – 30 years or at the best 50 years.

But life has to sustain itself for ever as per our wishes. So, we must discover, an energy source which works for many hundreds of years. Today, the only reliable potential source of energy, which can be relied upon for a couple of hundred years is nuclear energy. So, this must be our main source of energy.

2. Clean Source of EnergyThe fossil fuels like coal, oil and gas etc.

pollute the atmosphere. They generate wastes like flyash and green house gases. The green house gases are causing global warming. The consequences of global warming are disastrous as this is causing irreversible climatic changes. Melting of polar glaciers will submerge coastal lines, thus leading to large scale displacement of population. Therefore, it is important to relie on an energy source which is clean and will not contribute to emission of green house gases and global warming.

Nuclear energy is such a clean energy source. Therefore, it should be our main source of energy. 3.

Availability of Fuel in Friendly CountriesIf we take a look at uranium deposits or thorium deposits, we find that these deposits are located in friendly countries like Australia, Canada, India (Thorium only) etc. and therefore, to get fuel supply will not be a problem at all. This is in contrast to the oil reserves, which are located in gulf countries and islamic terrorists are strongly opposed to our domination in oil and gas exploration business over there.

This is causing lot of ill will between our citizens and Islamic terrorists. The acrimony is so bitter that the uncertainty over supply of oil and gas always remains and causes wild swings in prices of oil and gas. Besides, we have to wage many wars and spend a lot on the wars to protect our interests in oil and gas industry in the region. Thus excessive reliant on oil and gas is a big economic burden as well. If we swtich to nuclear power as main energy source, these problems will reduce to a great extent. It is not that we will not get oil, rather we will get it at much lower prices. As lowering demand of oil from US will lead to a big fall in oil prices, which is rising like anything. 4.

Maintaining Technological leadership: USA today enjoys technological leadership position on the globe. Riding on this technological leadership has come, economic leadership, military leadership and diplomatic leadership. As a leader of the globe it is but natural that US would like to maintain its leadership position in future as well. Now, we should look at how, technological leadership of US is connected with nuclear power.

If we explore the history, we find that pioneering in the nuclear energy arena was the first step, with which came technologial as well as all other forms of leadership. The nuclear energy is highly technology driven area. To remain leader in this field requires to have leadership position in the state of the art technologies.

This explains why not all the other nations have excelled in this area despite having all the other ingradients including local uranium reserves. It should be realized that a lot needs to be done to maintain technological leadership. While developing countries like India are putting lot of emphasis on thorium based futuristic nuclear program, US is confined to thermal reactors and that too is being opposed on many concerns. This way US cannot protect its leadership position in technological arena. It will be imperative to explore the different reasons opposing the nuclear power plants and scrutinising them. Concerns with Nuclear Power PlantsDifferent groups keep raising the bogey of opposition to the nuclear power. Following are some of the concerns raised by them. AccidentsAccidents are invariably associated with any industrial action including nuclear power production and one can not rule out an accident.

The accidents have an altogether different dimensions as these accidents involve release of radioactivity in the biosphere and thus affects a much larger flora and fauna and not a localized event like accidents in other industries. Besides, the effects of the accident is not localized in time, rather the effect remains for the decades to come. Also, some serious accidents in past have supported and in fact bolstered the cause of opposition of nuclear power plants. Some important accidents are Chernobyl disaster in USSR and Three Mile Island Accident in USA. In Chernobyl disaster, the entire core got melted followed by a explosion that rocked the reactor containment building. The activity spread in atmosphere and was carried by wind to as far as Western Europe and Eatern USA. About 200 persons were hospitalized out of which 30 died immidiately. More than 150000 people were evacuated.

The region became uninhabitable. The cancer rate has risen among those living around the area. The worst part of the accident was that the ataurities did their best to keep the accident hidden and it remained sectret from international community until it was detected by western europian countries. This also led to more damage as precautionary steps by adjoining countries were delayed.

In case of the Three Mile Island accident in USA, in 1979, there was partial melting of core. But fortunately, there was no loss of life as the reactor vessel did not rupture. Still, it was the worst accident in US nuclear power industry. Besides, there were smaller accidents involving leakage of activity from nuclear reactors and reprocessing plants either accidently or many times due to poor work practices. So, yes we do accept, there were accidents, but what we should infer from the accident. Should we stop our endevours.

No way, the accidents pose challenges before us and being a lively nation as we are we must take the challenges in right spirit and take appropriate measures to ensure that these accidents do not reocur. These minor hiccups should not be allowed to reverse as important a program as nuclear energy program, which is key to energy security of future. Attack by Rouge elementsIn case nuclear power plants are attaked, there will be enormous release of activity into biosphere, repeating another chernobyl.

In the present scenario, where islamic militancy is help bent to make at least a crude nuclear attack, the possibility of attack of a nuclear installation by terrorist groups have increased. It is a hard reality and nobody can deny it. Islamic militants may try to attack a nuclear power plant in a manner similar to World Trade Center and the disatrous consequences of the same is beyond imagination. But the question is should we give up out of fear of a couple of mindless people. Such people have been there for ever, trying their best to stall the journey of manking towards the path of progress. We cannot give up, however. Already, very tight security is maintained around a nuclear power plant and they are really a hard target to attack. What can be done is that security arrangements can be further tightened around the nuclear installations.

Besides, nuclear power plant, inclusing the core and the reactor containment building is a very robust structure and mild attackes is not going to damage it to the extent that there could be release of radioactivity in air. Safeguarding Nuclear WasteNuclear wastes like spent fuel etc. is also highly radioactive and in case rouge elements like terrorists could lay hand on these, they can make dirty nuclear devices. Such devices can be exploded by means of conventional exploves and spread radioactivity in a densly populated area, thus making the area uninhabitable. With more and more nuclear power plants operating around the globe and producing radioactive wastes, safeguarding these wastes will be a big problem and fear of rougue elements laying there hand on it will increase. The problem is a genuine one and needs to be tackled with seriusly. One very important way to do away with this problem is to adopt a closed fuel cycle.

In this fuel cycle, the spent fuel is processed and refabricated as reactor fuel. This approach is gaining popularity, however, technological challenges need to be overcome to adopt it. Besides, the wastes should be stored in a safe condition to prevent its access by rougue elements. Negative effects on Health of Working as Well as General PopulationPersonnel working in nuclear industry are exposed to radiation. Even general public is exposed to radiation, by different practices of the industry.

Sometimes excess activity is released in the nearby water stream, violating the standard practices. There is prescribed limits for radiation dose level to workers as well as to the public. But sometimes, these are violated and more exposure is given to innocent workers and general masses by shoddy practices. Radiation level beyond limit is known to have negative effects on human health. The concern is true, but it is due to wrong practices and therefore, limited to developing nations and practically absent in USA.

This can be taken care of by adopting standard work culture and can not be a legitimate excuse to going back on nuclear energy. Nuclear proliferationNuclear proliferation means spill over of fissile materials and know how pertaining to nuclear weapons into the hands of rouge elements. Because, the materials for civilian nuclear application can be diverted to military applications. While, one can not deny the argument completely, but this argument can not go against nuclear power as these concerns can be taken care of by appropriate international legislation and their effective enforcement. Air PollutionNuclear power plants release I-131 and Xe-133 in air and thus pollute the air, as these isotopes are radioactive. However, the amount of release is very small and can be ignored. Besides, amount of the atmospheric release can be checked by technological advancements.

The BottomlineWe have reviewed the basic scientific and techological aspects of nuclear power production, statistics of nuclear power production across the globe and in USA and scrutinized the different concerns related to nuclear power production. That nuclear power is the most viable option for future energy security of the nation and of the globe. Yes there are concerns associated with nuclear power production.

But we have to take the risks. There is an old saying that “ If you take risk, you may lose, but if you do not, you will certainly lose”. Therefore, we as a nation can not be risk averse after having taught the modern civilization the art and science of mastering risks in almost all spheres of life. Therefore, we as a nation must go for nuclear power as the main source of energy for the nation as it is the only reliable energy source for the energy security of future. References1. “ Global Uranium Resources to Meet Projected Demand”. International Atomic Energy Agency (2006). http://www.

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