The present invention relates to methods, structures apparatus and systems for preventing the airborne release of radioactive gases and particles and of radioactive and toxic liquids from a Nuclear Power Plant whose containment building (14) has failed during a (non-design basis) accident, (e.g. during a partial or complete core meltdown). The invention is inherently integrated with an overflow radioactive liquid storage system that simultaneously provides a hermetically sealed reservoir surrounding the reactor for containing and storing toxic and radioactive liquids which might accumulate during a reactor accident. In a preferred embodiment of the invention an inflatable dome design including a multiplicity of increasingly larger concentric domes (1, 2, 3, 4) are sealed to the ground or to the top of a subway ground system (5, 6, 7, 8). The spaces (10, 11, 12, 13) defined between the domes (1, 2, 3, 4) are connected to a control air filtration system.
* DESIGNATIONS OF “DE”

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APPARATUS FOR THE CONTAINMENT OF
NUCLEAR MELTDOWN DEBRIS

Technical field: The present invention relates primarily to nuclear power plants, and particularly to the containment of radioactive particles, and liquids in a building whose containment has failed. It secondarily relates to the containment of gaseous and liquid toxic materials released from chemical plants, laboratories and waste dumps.

Cross-Reference to Related Application: This PCT application presents selected sections of an application of the same name filed in the United States patent office on July 16, 1990, which was itself, a continuation in part of application Serial No. 07/379,777 filed July 14, 1989. Certain sections included in the original U.S. applications, (including figures 9, 10, 14, and 19) have been provisionally deleted from this PCT filing pending military declassification, and/or pending action from the Executive office of the White House.

BACKGROUND OF THE INVENTION

The present invention relates to methods, structures apparatus and systems for preventing the airborne release of radioactive gases and particles and of radioactive and toxic liquids from a Nuclear Power Plant whose containment building has failed during a (non-design basis) accident, (e.g. during a partial or complete core meltdown). The invention is inherently integrated with an overflow radioactive liquid storage system that simultaneously provides a hermetically sealed reservoir surrounding the reactor for containing and storing toxic and radioactive liquids which might accumulate during a reactor accident. In the event that the capacity of this reservoir is exceeded, or in the event of an accident in which radioactive materials are leaking through the primary cooling system, an expanding plastic barrier is incorporated into the design to isolate overflow or cooling
water containing such toxic or radioactive liquids from the "clean" water of an adjacent river or lake.

[The problems with current Nuclear Reactor Containment systems]

The massive concrete containments of nuclear power plants have numerous penetrating pipes, wires and openings which must be perfectly sealed to prevent the escape of radioactive gases in the event of a rupture of the pressure vessel or an internal explosion such as that which might occur from accumulated hydrogen gas. According to some experts (e.g. Zinovy Reyblatt, Ph.D of the Department of Mathematics, Illinois Institute of Technology, Chicago, Illinois), the containment buildings housing many of these plants are far from perfect and do in fact leak at unacceptably high rates (when pressurized).

The fact that many possible types of severe accidents could cause a containment system failure, including hydrogen explosions, steam explosions, high-pressure melt ejections, and bypass of the pressure suppression pool, was described in a briefing paper published by the Union of Concerned Scientists titled "Nuclear Reactor Containments: Sieve or Shield" in December, 1987 (Reprints may be ordered from UCS Publications Department, 26 Church Street, Cambridge, Mass. 02238, (617) 547-5552).

This article concluded that current containment systems are "necessary but not sufficient for reactor safety". This same article cites the study published in February 1987 by the US Nuclear Regulatory Commission titled "Reactor Risk Reference Document" (NUREG-1150) which described problems in all five different types of containments that are generally found in U.S. plants, and which concluded that none of the five systems are foolproof, and that "some designs are as likely to fail as not to fail in a severe accident".

The NRC's general requirement for containment design reads "Reactor containment and associated systems shall be provided to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment and to assure that the containment design conditions important to safety are not exceeded for as long as postulated accident conditions require." Again quoting the UCS paper:
"The key phrase here is 'postulated accident conditions'. In the US, as elsewhere, a containment is not designed to withstand every accident that can occur. It is designed to withstand only 'design basis' accidents without releasing more than an 'acceptable' amount of radioactive material. But all reactors can have accidents such as core melt downs or hydrogen explosions, that exceed the design basis of the containment. The Chernobyl reactor, although a different type than US plants, did have a containment, and its design basis was the same as that of US plants-- it was designed to withstand rupture of any one pipe within the containment. However, the accident was far more serious than that and overwhelmed the containment."

Even in the United States, containments are not required to be designed to remain intact in severe (non-design basis) accidents, such as those involving melting of the reactor fuel. It should be noted that no US reactor containment system would have withstood the 100 pounds per square inch overpressures which are believed to have accompanied the explosion at Chernobyl.

Additional Description of Mechanisms of Postulated Reactor Accidents Which Could Exceed Current NRC Containment Safety Criteria

In a Loss of Coolant Accident (LOCA), such as that which occurred at Three Mile Island, after minutes without effective cooling, the reactor core overheats and begins to melt. This releases radioactive elements into the pressure vessel atmosphere including various amounts of radioactive Tritium, Iodine, Cesium, Xenon, Krypton, Ruthenium, Tellurium, Barium, Strontium, Radon and Cerium. (Goldman, Mitchell P. and Crosson, Jessica, "What If? Medical Care in a Nuclear Accident. The New Physician, Nov. 81, P. 31.)

"The containment: Reactor containments are both massive and well equipped (Figures 1 and 2). Most are designed to withstand internal pressures of three to four atmospheres and may maintain their integrity [for brief periods] at more than six atmospheres internal pressure. They also have water sprays, water pools or compartments full of ice; whose purpose is to reduce pressures by removing steam.
from the containment atmosphere. Reactor containment buildings are not designed to contain a reactor core meltdown accident however. Their 'design basis accident' is a loss of coolant accident in which large amounts of volatile radioisotopes are released from a temporarily overheated core, but in which the uncontrolled release of energy form the core is terminated by a flood of emergency core cooling water before an actual meltdown occurs. This is essentially what happened during the accident at Three Mile Island, although, due to various errors, the core remained only partially cooled for a period of hours.

**The threat of overpressurization:** If for any reason the emergency core cooling system were not effective and a core meltdown occurred, the buildup of internal pressure in a sealed reactor containment building could rupture it within a matter of hours. The threat would come from steam, hydrogen and other gases. For an extended period of time after a reactor shutdown, the radioactive fission products in a reactor core generate heat at a rate great enough to turn hundreds of metric tons of water into steam per day (Figure 3). It would take only about 300 metric tons of steam [arising from 300 cubic meters of water] to increase the pressure inside even a large (60,000 cubic meter volume) Three Mile Island type of containment building by about ten atmospheres. It is apparent, therefore, that unless the containment cooling system operated reliably and effectively to keep this steam pressure from building up, the containment will quickly be overpressurized by steam alone, and would rupture within a few hours after a core meltdown.

Hydrogen is another potential contributor to the pressurization of the containment. It is produced when water or steam comes into contact with a metal which binds oxygen so strongly that the metal can take oxygen away from water molecules. Because it absorbs relatively few neutrons, one such metal, zirconium, is the structural metal of choice used in the cores of water cooled reactors. Zirconium starts reacting rapidly with steam at temperatures above 1,100 degrees C. About one half of the zirconium [11,300 kilograms!] in the core of Three Mile Island Unit No. 1 was oxidized during the accident there.
For a small volume (boiling water reactor type as seen in fig. 2) containment the mere pressure developed by the amount of hydrogen generated at Three Mile Island would have been enough to raise the containment pressure by one to three atmospheres. For a large volume containment (fig.1), the principal hazard associated with the hydrogen would be fire or explosion, and in fact the hydrogen did burn at Three Mile Island. Fortunately, however, the initial pressure in the containment building was such that the containment was able to withstand the resulting pressure increase of about two atmospheres. Some existing reactor containments would not have withstood the pressure rise associated with the burning of this much hydrogen, even given an initially low pressure" . . . (Jan Beyea and Frank von Hippel, "Containment of a Reactor Meltdown", August/September 1982 issue of the Bulletin of the Atomic Scientists (pages 52-59).

The remaining threat to containment integrity would arise from the carbon dioxide and carbon monoxide liberated as the molten core melted its way down through the concrete basement of the reactor building." (W. B. Murfin, Report of the Zion/Indian Point Study (U.S. NRC Nureg-CR 14091413, 1980) Summary, p. 49., and Jan Beyea and Frank von Hippel, "Containment of a Reactor Meltdown", Op. Cit. page 59, reference 8.)

Cooling water brought into contact with an overheated pressure vessel can cause cracks which lead to release of radioactive products. Within two hours, the occurrence of steam or hydrogen explosions can, with sufficient pressurization lead to containment failure. This permits escape of radioactive gases and steam into the atmosphere and eventual contamination of the food chain and possibly ground water. In addition to hydrogen explosions, other accidents that could result in containment failure include those that bypass the pressure suppression pool, steam explosions, and high-pressure melt ejection.

Returning to the UCS briefing paper, the following are possible:

"Pool-Bypass Accidents: In pressure suppression containments such as the GE Mark I and Mark II, steam flows from one part of the containment to another during a loss-of-coolant accident. A group of valves called vacuum breaker valves are used to equalize pressures between the two volumes. If these valves are open or leak, some
steam will bypass the pool and not be condensed. This could overpressurize and rupture the containment. In such an accident the containment collapse could also destroy the emergency core cooling system, leading quickly to a core meltdown and a direct radiation release to the environment. Similar accidents can occur in ice condenser containments if the steam bypasses the ice and is not condensed.

**Steam Explosions:** Molten metal dumped into water can produce an explosion of high pressure steam. In a meltdown the molten fuel (uranium dioxide melts at about 5000 degrees Fahrenheit) could drop into the bottom of of the reactor vessel against the containment wall, almost certainly rupturing the wall. Such an accident, says the NRC, 'cannot be ruled out completely on the basis of present evidence.'

**High-Pressure Melt Ejection:** All reactor cooling systems operate at high pressure. Bolling water reactors typically operate at about 2200 psi. It is possible for a reactor core to melt while the cooling system stays at high pressure. If that happens, the molten core could flow into the bottom of the cooling system. This high-pressure melt ejection could splatter the containment with molten metal, leading to containment failure" ("Nuclear Reactor Containments: Sieve or Shield? Union of Concerned Scientists Briefing Paper, Op. Cit., UCS Publications Department, 26 Church Street, Cambridge, Mass. 02238, (617) 547-5552.)

**Containment System Leak Rate Testing.**

Containment leak rate tests are done to ascertain that during an accident, the radioactive gases released into the containment building will not contaminate the environment. These tests are done periodically and prior to starting the operation of any plant, and consist of pressure and temperature data collected during a trial pressurization of the building. Quoting again from the above noted briefing paper . . . ."The NRC generally allows less than one percent leakage per day for reactor containments" . . . . (The inventor, who was Board Certified by the American Board of Nuclear Medicine in September 1986 as an expert in the field of Nuclear Medicine, asserts that this is far too lenient a criterion, that the assumptions that such levels of containment and leakage rates pose "no immediate
danger" to populations downwind of the plants are fallacious, and that radiation releases considered "acceptable" by the Nuclear industry and the NRC today, shall ultimately be proved conclusively to be epidemiologically responsible for a statistically significant number of cancers and other illnesses in the populations downwind of Nuclear Plants in the United States and elsewhere.)

"... "Containments have scores of penetrations--places where pipes, instruments, and cables enter the containment structure to provide the reactor with water, to power safety equipment, or to monitor conditions. In the case of boiling water reactors (most commercial reactors in the US are either boiling water reactors or pressurized water reactors, depending on whether steam is generated in the reactor vessel itself or in a steam generator), the main steam lines which carry steam from the reactor to the turbine-generator, are containment penetrations. Valves and welds can leak compromising containment integrity. Containments also have doors and hatches through which workers enter to perform maintenance or repairs, and these can leak. The result is that containments often do not provide the leak-tight shield the regulations call for. A 1980 study done for American Nuclear Insurers found that during the period 1967-1979, boiling water containments were leak-tight only 77% of the time...""

It is currently believed that substantial numbers of Nuclear Power Plants in the United States would allow significant leaks into the Environment of radioactive gases in the event of a (non-design basis) accident, and that fundamental problems in containment system design and performance during an accident may exist on a wide scale. (References include above noted UCS briefing paper, as well as the aforementioned article by Jan Beyea and Frank von Hippel published in the August/September 1982 issue of the Bulletin of the Atomic Scientists titled "Containment of a Reactor Meltdown" (pages 52-59). Other references include "O-rings and Nuclear Power Plant Safety" by Daniel Ford and Robert D. Pollard, published by the Public Citizen Critical Mass Energy Project, and multiple articles written by James Lawless, Peter Geller, Keith Epstein and Bill Sloat in the Cleveland Plain Dealer in June 1987, and personal conversations between the inventor and Zinovy Reyblatt, Ph.D. since 9/11/87.)
It has been estimated that in the event of a major accident, from 1/3 to 1/2 of the containment buildings in the United States could fail. (Quote attributed to Mike Weinstein of American Nuclear Insurance by Zinovy Reyblatt, Ph.D. of the Department of Mathematics, Illinois Institute of Technology, Chicago). Ninety six million Americans live within 50 miles of a reactor according to the Public Citizen Critical Mass Energy Project (of Washington, D.C.).

[Additional urgent factors demanding immediate revision of reactor and containment system safety criteria, and mandating retrofit of present invention]

The next major reactor accident, in all likelihood will not be exactly like Chernobyl, where the containment building instantly failed, or like Three Mile Island, where supposedly "superior American technology" protected the country, but will probably involve levels of containment in between, with internal pressure, or an explosion, or an earthquake leading to containment building fracture, or cold temperatures leading to a leak around some "O-rings" surrounding pipes penetrating the containment building. Should this happen in almost any American reactor, and the leak rate be sufficient to release substantial quantities of radioisotopes into the environment, the population will be forced to deal quickly with problems which are probably not at this time, even comprehended by the US Nuclear Regulatory Commission, such as the genetic mutation of viruses. This poorly appreciated problem makes the adoption of the present invention or similar means to increase containment integrity, an urgent international priority. The following is a summary of these (comparatively recent) microbiological and immunity factors which demand the immediate re-evaluation of containment systems for non-design basis accidents.

Briefly, microorganisms have short cycles of reproduction which allow for genetic mutations to occur rapidly. If irradiated, the rate of viral mutation is accelerated, as are the total number of mutant strains. The human population has in recent decades developed a multiplicity of chemical toxicity and immunosuppressive weaknesses which increase susceptibility to damage due to radiation. AIDS is already,
without additional irradiation (other than that received by medical X-ray, nuclear medicine studies, and background radiation, among the fastest mutating viruses in history. The HTLV 1,2,3 numbering system grossly understates the huge variety of AIDS viruses currently on the market. Nuclear industry assurances to the contrary, isotopes taken up into the body after a reactor accident continue to irradiate the victims for periods of days, months or years following an accident depending on the half-lives of the isotopes involved. While the genetic diversity of a microorganism population will increase with mutation and some mutants (as featured in the fictional book *The Andromeda Strain* by Michael Crichton) will undoubtedly be harmless, on the whole, natural selection will favor the survival of the fittest microorganisms, and many of these will undoubtedly not be harmless.

Significant numbers of individuals are now infected with various AIDS viruses and other new and virulent bacteria, viruses and viroids in epidemic proportions. Any student of genetics learns that radiation increases the rate of viral mutation, so a significant radiation release which contaminated infected individuals (with ingested or inhaled radioactive isotopes) can reasonably be expected to increase the virulence of any infectious organisms. At the same time, radiation has the universal effect of suppressing the immune response of the host. Most frightening is the fact that AIDS viruses are already mutating more rapidly than virtually any known virus. Even without the help of [the additional mutagenic effects of] a reactor accident, some scientists have speculated that it may be only a matter of time before this virus mutates into a form which could be transmitted even more readily than its present form. The urgency of preventing irradiation of the human population from careless accidents and radiation releases from Nuclear facilities has never been greater. In the event of contamination of an infected population from an accident not contained by devices such as those described herein mutation of AIDS to a form transported by respiratory route is possible. (H. Charles Kaplan, M.D., "Nuclear Power Plants, Viruses and Earthquakes", *The Journal of Environmental Radiology*, Vol. 1, Number 1e, page 18 9/2/89, revised 4/22/90, Available for $35.00 postage paid from
Radiologists for a Safer Nuclear Agenda, Suite 2700, 1340 West Irving Park Road, Chicago, Illinois 60613).

It would be wise to realize that, based upon the considerations described in the above section survival of the human race may be dependent on prevention of radiation doses which are considered non-lethal by the standard applied by most health physicists, which are based on the pre-AIDS era of Hiroshima, Nagasaki, and the relatively uninfected population around Chernobyl. The field of radiation risk assessment has virtually ignored viral (and bacterial) mutation risks. Re-evaluation of risk demands immediate consideration by radiobiologists and radiologists (as well as by the Nuclear Regulatory Commission). The risk of AIDS mutation (and of the possible adverse mutation of any of the multiplicity of other microorganisms present in AIDS patients) may increase the urgency of minimizing radiation exposure.

While the probability of an accident of the magnitude of Chernobyl occurring in the near future may seem remote, even the Nuclear Regulatory Commission admits the possibility of a major accident, with estimates of up to a 45% probability of a major core meltdown in one of the plants in operation in the U.S. within the next 20 years [estimate attributed to James K. Asselstine, former NRC Commissioner. In May, 1986 Mr. Asselstine wrote: "unfortunately both the nuclear industry and its regulator, the Nuclear Regulatory Commission have lost sight of the need for absolute nuclear safety. Constant vigilance has been replaced with an attitude of complacency." He went on to write "Safety analyses of several U.S. nuclear plants indicate there is a 45 percent chance of a core meltdown in one of the 100 plants now in operation in the U.S. in the next 20 years." In a later discussion Mr. Asselstine noted that some estimates have placed the probability of a meltdown as high as 99% in this period.

The inability of many U.S. reactors to pass [even the absurdly lenient 1% per day leak rate design-basis] integrated pressurized leak rate tests documented by the research of Zinovy Reyblatt, Ph.D. and in the Cleveland Plain Dealer articles of June, 1987, would suggest that extra containment protection could be essential to human health. The
public relations value of erecting these auxiliary inflatable containment domes would almost certainly be positive. Again, the purpose of the dome(s) is to contain the leaking radioactive gases until they can be trapped by the auxiliary air filtration system. The prevention of even extremely low concentrations of airborne contamination is fundamental to the safe operation of any nuclear facility, and the containment systems described herein are similarly applicable to fuel manufacturing, radiochemical laboratory, nuclear weapons plants as well as chemical plants using or manufacturing gaseous and liquid toxic materials. These designs could have, for example, protected the population around the city of Bhopal, India during the Union Carbide catastrophe.

The problems inherent in [Nuclear] Power Plant Containment Integrity may not be insoluble. The long term prospects for the continued use of Nuclear Power, however, demand that the industry address the safety issues more convincingly than they have done thus far. Several European countries have adopted design modifications of their reactor buildings which permit release of pressure from reactor containment buildings through specially designed single pass filters which trap radioactive particles and gases (Figure 4). These systems suffer the drawback that, while offering some protection against large releases of radioactivity, to the atmosphere, they may increase, by an uncertain amount, the frequency of public exposure to smaller releases not effectively trapped in a single pass system. They may also fail to operate properly, or fail entirely, in the event of a containment system breach and reactor accident initiated by an earthquake. They also have no provision at present for safely changing the underground filter system which itself is susceptible to saturation and to disruption by earthquake. The present invention features several dramatic improvements over the European single pass filtered-vent designs, which could, incidentally be incorporated in principle into the present invention, by the replacement of the "buried" single pass through vent-filter interfaced between the containment building and the atmosphere with a design having interchangeable filters which interface the containment building's enclosed air-space through a solenoid-actuated, pressure-sensor-thresholded valve to the air space
under the inner dome. Although not without expense, the designs described herein can be adopted in American plants and can be retrofitted with minor modification to any Nuclear Power Plant, including those already having the above noted "pressure release filters", to provide significantly improved containment system safety.

SUMMARY OF INVENTION

The present invention defines systems, methods and apparatus pertaining to the use of auxiliary inflatable or otherwise erected dome containment structures for covering and sealing the air-space over Nuclear Power plants so as to trap escaping [radioactive] gases until a recirculating air filtration system can remove escaping radioactive particles and gases and trap them in replaceable filters which could be advanced into a leaded box by a remotely controlled automated mechanism (or if this mechanism were to fail, by a robot). The optimal arrangements of concentric inflatable domes (or rigid domes with expansible sections) with respect to possible connections to recirculating and single pass filtration systems under and between domes is described. Methods and optimal apparatus for monitoring the contamination of various air spaces and spaces potentially containing radioactive water are described. Methods and apparatus are described for minimizing the exposure of personnel working in such a plant to these radioactive gases, and particles, including automated filter changers with inflatable gasket seals, and an isolated, pressurized (preferably underground) escape route leading to a separate, air-tight pressurized auxiliary control building outside of the inflatable domes which could contain decontamination showers, monitoring and control equipment, and additional lead earth and/or concrete shielding to reduce worker radiation exposure. This escape pathway from the main control building of the plant under the domes to the auxiliary control building outside the domes, is pressurized from outside to a pressure in excess of that of the inner dome, and interfaced to the outside via an air lock in the auxiliary control building, so as to provide safe breathing air for plant personnel in both control buildings and in the underground tunnel. Air locks appended
to the inner control building will permit workers in radiation suits or robots to access above ground equipment including the containment buildings.

These structures could be erected during an accident in an emergency such as an earthquake, but would preferentially be erected before an accident occurs to serve as additional levels of protection by virtue of the auxiliary inflatable containment building's abilities to prevent the release of radioactive particles or gases into the environment which have escaped from a damaged or defective containment building. Although the drawings specify a series of inflatable domes, the scope of the invention would also include rigid domes with appended expansible sections which could be similarly connected to the specified filtration systems. Also included in the present invention is a series of "single-pass" overpressure filters which permit release of volumes of contaminated air from the reactor containment building to the innermost dome and from each inner dome through the overpressure filter to the next concentric dome by virtue automatically changeable filter cartridges similar to those used in the recirculating filter system.

The arrangement of fans, vents, ducts and dampers is described to optimize the air flow into the changeable filters. Although described for Nuclear Power Plants, the present invention is equally applicable to protection from downwind spread of toxic chemicals, or biologically hazardous materials from chemical plants, and to the prevention of release of airborne particles from toxic or radioactive waste dumps, fuel fabrication or processing plants, radiochemical operations, laboratories, and other nuclear operations.

The ideal implementation of the invention, by virtue of the circular trench subway system needed to house and access the underground ducts, fans, and filter changers, inherently creates a geometrically ideal (earth shielded) housing for a cyclotron (actually a synchotron) which could utilize electric power from a circumferentially surrounded reactor during non-meltdown periods to produce particle beams which could be directed at targets of made of reactor generated isotopes for high energy physics experiments. Because this large underground circular trench is built of steel-
reinforced prestressed concrete (earthquake resistant design), and interiorly lined with poured or sprayed glass, it forms a hermetically-sealed, leak-proof "moat"-reservoir, capable of storing large volumes of any overflow radioactive liquids (such as contaminated cooling water) which might need to be pumped from the containment building during an accident, until a recirculating liquid filtration system could remove the particulate, dissolved gaseous, and ionic radioactive contaminants.

**BRIEF DESCRIPTION OF THE INVENTION:**

The invention consists of 4 integral parts:

**PART ONE: AUXILIARY INFLATABLE AIRBORNE PARTICULATE CONTAINMENT DOMES AND AIR FILTER SYSTEMS**

**PART TWO: INTEGRATED TRENCH-SUBWAY RADIOACTIVE LIQUID RESERVOIR CYCLOTRONIC CONTAINMENT SYSTEMS**

**PART THREE: EXPANDING PLASTIC BARRIER FOR ISOLATION OF OVERFLOW CONTAMINATED LIQUIDS FROM LAKES AND RIVERS**

**PART FOUR: FISSION RADIATION NEUTRALIZER SYSTEMS**

Part 1 describes various apparatus related to the covering of Nuclear Power Plant buildings with concentric inflatable or rigid domes interfaced to recirculating air filtration systems, and to pass through filter systems interfacing between the containment and inner dome, and between adjacent concentric dome. The concentric inflatable (or rigid domes with expansible sections) fit over a glass-lined circular subway "trench" which houses under-dome air and liquid filtration systems and fissile isotope neutralization systems for these purposes.

Part 2 of the invention entails the containment of radioactive liquids in the glass-lined circular subway "trench", which may overflow from a containment building during a meltdown, and the filtration of those liquids using recirculating filter systems and pumps to move these liquids from the containment building into the trench, or into the reservoir created by the expanding plastic barrier invention described
in Part 3. Again, the filters in the liquid filtration system will be isolated in lead shielded casings and are changed by an automated mechanism, or a robot. In addition to standard methodologies of filtration, the liquid filtration system would include a filter having a superconducting magnet trap, shielded by lead to filter out any magnetically attractable particles, including custom designed chelating agents chemically bound to ferrous or other magnetic materials, designed to remove specific isotopes from solution.

Parts 1 and 2 of the invention also describe methods and apparatus for minimizing the exposure of personnel working in such a plant to these radioactive gases and particles including automated filter changers, multiple system point radiation monitoring and an isolated, pressurized escape route leading to a separate air-tight pressurized building which could contain decontamination showers, monitoring and control equipment.

Although described for Nuclear Power Plants, the present auxiliary inflatable containment dome invention (part 1) is equally applicable to protection from downwind spread of toxic chemicals, or biologically hazardous materials from chemical plants, and to the prevention of release of airborne particles from toxic or radioactive waste dumps, fuel fabrication or processing plants, radiochemical operations, laboratories, chemical biological warfare installations, and other nuclear operations, and parts 2 and 3 are equally applicable to prevention of release of toxic or radioactive liquids from these plants.

When applied to a Nuclear Power Plant, the ideal implementation of all parts of the invention, create an integrated system in which the glass-lined sealed circular trench subway system is used both to house the underground ducts, fans and filter changers, and also designed to act, in an emergency as a storage reservoir for the overflow of radioactive liquids such as contaminated cooling water, which might need to be pumped out of a damaged containment building until a recirculating liquid filtration system could remove the particulate, dissolved gaseous, and ionic radioactive contaminants. When there is no accident in progress, this circular trench subway
system could either support a permanent rigid or inflatable dome which could be in place in advance of an accident, or could store a series of rigid corrugated dome sections that by prior fitting to a superstructure and hydraulic drive could rise from the trench quickly to form a dome entirely enclosing the station. Alternatively, an accordion folded, multi-layer inflatable dome in the trench could be drawn over a series of "ribs" (as a shower curtain slides on a rod) to form a series of concentric domes which enclose the entire structure and seal it circumferentially to the ground in communication with an air filtration and fissile product neutralization system. Several alternative geometries of dome design are described.

During periods in which there is no accident in progress, the glass-lined circular trench surrounding the reactor inherently creates a geometrically ideal underground housing for a cyclotron which could utilize electric power from the reactor during non-meltdown periods to produce particle beams which could be directed at targets made of reactor generated isotopes or toward the beams from other reactor encircling cyclotrons for production of cyclotron based isotopes and high energy physics experiments.

Part 3 of the present invention creates a large reservoir along the edge of a lake or river for toxic and radioactive liquids in which a plastic "pocket" surrounded on one side by water isolates contaminated from uncontaminated liquid. The isolated liquid so enclosed, could be filtered by similar liquid filtration, systems including superconducting magnetic trapping of isotopes via chelation agents chemically bound to ferrous or magnetic materials. This section of the invention could also be implemented to force polluters of water to process their waste water before discharging it into lakes, rivers, or streams.

Part 4 of the invention augments and then replaces the automated air-filter changers and motor driven fan systems with a more preferred embodiment which utilizes a fissile isotope neutralization system which accelerates the decay of fissionable isotopes trapped within the neutralizers and renders them non-radioactive by processes which are proprietary, provisionally classified and deleted from this application.
BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings forming part of the specification, in which like numerals are employed to designate like parts throughout the same,

Fig. 1 is a simplified schematic view, in cross section, of a typical, conventional pressurized water nuclear reactor containment;

Fig. 2 is a simplified schematic view, in cross section, of a typical, conventional boiling water nuclear reactor containment;

Fig. 3 is a graph showing potential steam production;

Fig. 4 is a simplified, schematic diagram of an underground "European-style" single-pass pressurized water reactor containment building filter vent system.

Fig. 5 is a simplified, schematic plan view of a portion of the air supported dome containment system of the present invention;

Fig. 6 is a simplified, schematic side elevational view, partially in cross section, of the air supported dome containment system of the present invention with portions broken away to better illustrate interior detail;

Fig. 7A is a simplified, schematic end cross-sectional view of the system of Fig. 6;

Fig. 7B is a view similar to Fig. 7A, but with the system shown in a particular mode of operation;

Fig. 8A is a simplified, schematic elevational view of the fission particulate neutralizing generator employed in the present invention;

Fig. 8B is an enlarged view of the slide employed with the neutralizing generator;

Fig. 9 is a schematic diagram illustrating in a simplified manner some electrical features of the neutralizing generator;
Fig. 10A is a simplified, schematic diagram, in plane view, of the shaft and of a representative lobe;

Fig. 10B is a simplified, schematic diagram showing further lobe details;

Fig. 11 is a view similar to Fig. 10A showing a form of one lobe;

Fig. 12 is a view similar to Fig. 10B showing three lobes;

Fig. 13 is a simplified, schematic representation of a side elevation view of the shaft and lobes;

Fig. 14 is simplified, schematic diagram in elevation showing some features of the subway system;

Fig. 15 is similar to Fig. 14 but showing some of the features in more detail;

Fig. 16 is a greatly simplified, schematic, elevational, cross-sectional view showing an alternate form of the containment system of the present invention;

Fig. 17 is a simplified, schematic plan view of the alternate containment system of Fig. 16;

Fig. 18 is a simplified, schematic view, in side elevation and partially in cross section, of a second alternate form of the containment system of the present invention; and

Fig. 19 is yet another simplified, schematic diagram of certain electrical features of the fission particulate neutralizing generator employed in the present invention.

Fig. 20 is a detail drawing of an automated filter changer, with inflatable gasket seals and showing advancement of fresh filters from subway and used filters being dropped into leaded box in subway.

Fig. 21 shows this filter changer in operation as a pass-through vent-filter.

Fig. 22 demonstrates similarly configured recirculating filter system changer with underground lead box in subway.
DETAILED DESCRIPTION OF THE INVENTION and the DRAWINGS

The following plan outlines a design for a series of inventions which may offer additional levels of emergency protection to the environment and the human population via auxiliary methods of containment of air-borne and liquid nuclear debris resulting from a meltdown.

Feasibility of implementation of invention using existing technology
Part 1: Inflatable dome technology

The technical feasibility of erecting the proposed auxiliary inflatable containment invention (part 1) has been confirmed by at least one American company (ESI---Environmental Structures Inc., 7600 Wall Street, Cleveland, Ohio 44125). Robert Ross, Ph.D., vice president in charge of engineering has affirmed that he believes the inventor's claims that the proposed invention, using the designs described herein with their current inflatable dome technology, will withstand gale force winds, and earthquakes; will contain the expected outflow of heated radioactive gases and steam in the event of a meltdown, and will furthermore provide a unique method of providing an additional isolated cooling system for the escaping heated radioactive gases and steam. The latter feature is inherent in the inflatable dome designs manufactured by ESI in which fiber reinforced plastic sheets are joined in a multiplicity of parallel seams, in which steel aircraft cable is laminated, to form a multiplicity of parallel tubular air channels which can serve to conduct cooling air from a sill which surrounds the enclosure which is isolated from the air spaces on either side of each dome. Expandable sections can be provided through the placement of concentrically larger domes with duct and vent selection to pass air through filters before traversing into the next most outer dome. The provision of 2 or more enclosed air spaces, with concentric provides the possibility of pressurizing an inner dome to force air through a single pass through filter into an outer dome connected to fan intakes, or of simply filtering the air under any one dome using a "recirculating" air path in which the air under any given dome is filtered at the intake of a fan system which empties into that same dome system. An alternative method of providing an expansible air-space is suggested but not illustrated in
which servo controlled reels containing rolled ESI film sealed to the
ground by a gasket or skirt at one edge the dome, could unreel
additional plastic as the inflated volume increases. The plastic sheets
can be manufactured of materials which will not support combustion
into arbitrarily large sizes, with projected lifespans of 10 to 15 years
once deployed as domes. In the event of damage, an inflated cover
can be rapidly and safely replaced with a new one as the damaged one
is removed and deposited into a lead lined sac.

Although unique to the present invention, the automated
deployment of a prefolded multisheet dome pulled (as a shower
curtain on a rod) over a series of ribs which are drawn out of an
underground trench by a chain drive and track monorail system is
technically uncomplicated and is analogous to the design described
below for the track monorail system in Alternate Dome Design #2.
The present invention claims basic patent rights for all similar
applications of dome and filtration technology described herein and is
not restricted to any one geometry, or combination of geometries or
dome designs. Specific preferred designs will be illustrated for domes
having both circular and a rectangular foundations, of both inflatable
and rigid, concentric and non-concentric designs.

Part 1: Existing nuclear air cleaning technology

The technology of nuclear air cleaning filtration systems is well
developed. "A nuclear air cleaning system is provided to protect the
public and plant operating personnel from airborne radioactive
particles and gases which are, or could be generated or released from
operations conducted in a nuclear reactor, fuel fabrication or
processing plant, radiochemical operation, laboratory, or other nuclear
operation. Such a system is characterized by operation at very high
contaminant collection levels, generally orders of magnitude greater
than those exhibited by air cleaning systems employed in commercial,
industrial, or pollution control applications. The component almost
universally included in such systems is the high efficiency particulate
air (HEPA) filter. This type of filter may be supplemented by common
air filters, bag filters, cyclones, scrubbers, or other devices used in
more conventional applications but is nearly always employed in the
nuclear air or gas cleaning system as the final barrier between a contained space (in which radioactive particulates could be generated) and the point of release to the atmosphere (i.e. the stack) or to an environmentally controlled space of the facility. (C. A. Burchsted, J.E.Kahn, and A.B. Fuller, *Nuclear Air Cleaning Handbook: Design, Construction, and Testing of High Efficiency Air Cleaning Systems for Nuclear Application* Energy Research and Development Administration publication ERDA 76-2, Oak Ridge National Laboratory, Oak Ridge Tennessee 37830, 7/10/69, revised 3/31/76, page 1.)

By definition, a HEPA filter must have a minimum number efficiency of 99.97% for .3μm particles; that is, a number decontamination factor of at least 3333 for all measurable particles of any concentration, down to at least a .3μm aerodynamic diameter. Similarly, the Iodine adsorption units used in nuclear air and gas cleaning service must also exhibit collection(i.e. decontamination) efficiencies substantially greater than adsorption units used in fume and odor control and most toxic or noxious gas control applications. For these components to function at their required performance levels, the manner in which they are installed, the collecting duct work, and the ancillary components required to complete the air cleaning function must be all meet standards of design and installation substantially higher than those which prevail in most non-nuclear stations." C. A. Burchsted, et. Al. *Nuclear Air Cleaning Handbook: Design, Construction, and Testing of High Efficiency Air Cleaning Systems for Nuclear Application*, Op. Cit. Page 2)

**Earthquake:** The problem of earthquake arises from the possibility of malfunction of fans, dampers, filters, or other functional components of the system, or rupture or structural damage of the pressure-boundary components (ducts, housings, fan or damper casings) when the system is subjected to rapid, violent repetitive shaking or dislocations, either as a lumped mass or as parts of the assembly are dislocated independently relative to one another. Fortunately, the physical masses of air cleaning system components are generally small relative to the massive concrete building elements to which they are anchored; if the natural frequencies are greater than about 30 Hz and
the parts of any single air cleaning unit are anchored to the same building element, a satisfactory earthquake resistant air cleaning system can be achieved fairly easily. Problems arise when portions of the same air cleaning unit (e.g. different segments of the ductwork are anchored to different building elements that can vibrate independently.) C. A. Burchsted, et. Al. Nuclear Air Cleaning Handbook: Design, Construction, and Testing of High Efficiency Air Cleaning Systems for Nuclear Application, Op. Cit. Page 223)
(The present invention circumvents the problem noted in the last sentence by securing all air cleaning components to the cast reinforced concrete continuous circular trench subway foundation.)

Part 2: The circular trench subway liquid reservoir uses readily available earthquake resistant technologies of pre-stressed reinforced concrete construction which have been developed to “harden” the underground foundations for ballistic missiles and to create existing large reactor containment buildings. The technology for pouring or spraying a molten glass lining also exists. The technology for pumping and filtering radioactive and chemically contaminated liquids which might be dumped into this trench reservoir system and the technology of monitoring areas of such a pump and filter system for pressure and radioactivity also exist. In addition to standard methodologies of filtration, the liquid filtration system would include a filter having a superconducting magnet trap, shielded by lead to filter out any magnetically attractive particles, including custom designed chelating agents chemically bound to ferrous or other magnetic materials, designed to remove specific isotopes from solution.

The installation of a cyclotron inherently requires the specified geometric shape, and the location circumferentially surrounding a reactor makes ideal use of the availability of electric power and unique target isotopes. In states and countries having multiple reactors, the development of multiple reactor powered cyclotrons which is facilitated by this invention may provide multiple feasible paths between reactors for colliding beam experiments.
Part 3: The application of this identical multilaminated ESI dome material to the storage of toxic or radioactive liquids has no precedent known to the inventor, but likewise poses no technical difficulty. Basically, one edge of a large piece of double layer plastic sheet (preferably bi-laminated in a manner similar to the products manufactured by ESI to multiple parallel steel cables) is secured along a long (several hundred of thousand foot length) of shoreline. In the ESI design, this could be accomplished easily by filling one or several of the parallel tubular channels (created by the parallel laminated wire containing seams) with sand. Several of the parallel tubular channels at the edge of the plastic distant from this secured edge are inflated with air or filled with a buoyant material such as Styrofoam, and this edge is free to move outward as toxic or radioactive liquid poured on top of this plastic sheet displaces the water below the sheet. This invention creates a plastic "pocket" to isolate contaminated from uncontaminated liquid. Alternatively all free edges of the plastic "pocket" may be secured at the edge of the shore to a metal sill with a compressible seal to hermetically seal all edges except for an inlet pipe for contaminated water which would thereby enter the isolation pocket. The isolated liquid so enclosed, could be filtered by recirculating liquid filtration systems similar to those described above including superconducting magnetic trapping of isotopes via chelation agents chemically bound to ferrous or magnetic materials.

In the preferred embodiments of the inflatable dome designs, a multiplicity of increasingly larger concentric inflatable domes 1,2,3,4 which are independently sealed to the ground or to the top of a subway trench system 9 via separate sealed foundations 5,6,7,8 are deployed to create multiple enclosed concentric volumes 10,11,12,13 enclosing the space over the nuclear reactor 14 (and the control building 15). (Figures 5-7). The space so defined under the inner dome and between each pair of outer domes can be independently connected to, or disconnected from a central recirculating air filtration system comprised of sixteen vertically mounted turbine fans 16 (which in the present design rotate clockwise) attached to tubular intake 17 and outflow 18 ducts. Figures 5 and 6 depict one of several possible configurations of intake and outflow ducts, but are not
intended to restrict the claims or scope of the invention to this geometry. The fans are arrayed here as four groups of 4 (a,b,c,d) fans. As seen in Figure 1 detail #29, within each group of 4, fans A and C share common intake ducts and fans A and B share common outflow ducts, while fans B and D share an adjacent different common intake duct and fans C and D share an adjacent but different common outflow duct. This arrangement permits any one of the 16 fans to move air from any air space to any of the other air spaces 10,11,12,13 under the domes, in the event that any combination of the other 15 fans is disabled, or any separated part of the underground subway system adjacent to one group of 4 fans becomes contaminated, leading to shutdown for decontamination. Each fan motor is on a separate and independent electrical line which is separately connectable to one of a multiplicity of electrical power sources. Although not clearly illustrated in Figure 1, the intake ducts (17) provide access to outside air as well as to the air space under any given dome via a (non-illustrated vent 26) which interfaces with the outside. This permits inflation of the domes to high pressure to "stiffen" the structure during inclement weather with high winds.

The underground subway system 9 in the preferred embodiments would consist of a circular trench ringing the entire installation at a minimum of distance of 35 to 40 feet off the perimeter from the edge of the reactor or control buildings which would provide access to automated filter changers and filters. The trench would be designed of reinforced concrete and would be lined interiorly with glass (either poured or sprayed: not piece fitted). When surrounding a Nuclear Power Plant, the ideal implementation of the invention, by virtue of this circular trench subway system needed to house the underground ducts, fans and filter changers, inherently creates a geometrically ideal underground housing for a cyclotron which could utilize electric power from the reactor during non-meltdown periods to produce particle beams which could be directed at targets made of reactor generated isotopes for high energy physics experiments. The glass lined sealed subway system 9 is also designed to act as a storage reservoir for the overflow of radioactive liquids such as contaminated cooling water, which might need to be pumped out of a damaged
containment building until a recirculating liquid filtration system could remove the particulate, dissolved gaseous, and ionic radioactive contaminants. The underground circular glass-lined trench subway system preferentially also contains separated and sealed underground sub-sections for each group of fans to permit isolation of a leaking system.

If automated filter changers (figure 22) are also located over the "outflow" vents 25, one could envision the reversal of the pair of fans connected to any output duct 18, as permitting an air-flow pattern optimal to the selective removal of radioactive debris adjacent to the output vents 25. It also provides a pair of fans on each main intake duct 17 and a pair on each main outflow duct 18. Sliding dampers over each main fan inlet 26 similarly sealed with inflatable gaskets will permit shut-off of inflow for access to fan for servicing.

Since the purpose of the fans is to pull any contaminated air into the filters as quickly as possible, the design specifications intend to change the volume enclosed by a half-maximally inflated dome system during a "non-design basis" accident, at least once per minute (maximal volume of outer dome to enclose approximately 120,000 tons or 68,571,428 cubic meters of air; i.e. 1,000 times the internal volume of a large typical reactor containment building). In the preferred embodiment, the sixteen intake fans are therefore specified as collectively moving 60,000 tons (120,000,000 pounds or 34,285,714 cubic meters) of air per minute. This translates to 3,750 tons (7,500,000 pounds or 2,142,857 cubic meters) per fan per minute. Although the groups of 4 fans are shown as square arrays from above in Figure 1, they may alternatively (as noted above) be arrayed linearly or semi-circularly around the inner perimeter of a circular dome enclosure with the same redundancy of input and output connections diagrammed schematically in Figures 5 and 6. Ideally, (although not illustrated), there would be additional intake vents 21 and automated filter changers 20 adjacent to the reactor buildings 14.

An underground escape tunnel 31, provides an escape path for personnel in the reactor control building 15 under the domes to an auxiliary control building 30 outside the domes, pressurized above the level of the air under the inner dome by independently powered
filtered air compressors located in an adjacent air tight building 33. Access to the auxiliary control building is via airlock32. Pass-through filters 34 with automated filter changers, located between each dome permit air to be transferred through filters at various circumferential locations from one dome to an adjacent concentric dome. Warning Beacon with antenna 35 provides marker of top of dome to approaching aircraft and transmits data about state of all containment systems to remote location.

An alternative, simpler, and postulated optimal geometry for the ultimate preferred embodiments of the present invention (Figures 15,16,17,18) features a circular subway trench system surrounding the reactor and control buildings and connected via a single continuous circular duct to a multiplicity of vertically oriented, equally spaced turbine fans whose mouths are attached to automated filter changers and ducts which similarly access all domes via a duct system which is attached to damper/interfaced vents which allow the upper portion of each fan casing to interface with any combination of domes. If every other fan turns in the opposite direction, this system will provide alternating, circumferentially distributed intakes and outflows in which any fan could be reversed, after changing its filter to selectively change the local air flow pattern at will. This design will simplify the connections and duct-work and will permit all equipment to be placed in a single circular subway which could by virtue of its geometry, incidentally be utilized simultaneously to house a cyclotron which could derive power from the reactor. In all possible geometries of the present invention, the subway trench system would be a minimum of 16 feet wide, and 28 feet deep, constructed of reinforced concrete (as in Earthquake-proof construction) and is interiorly lined with glass. Plastic is not suitable, although "filter glass" or "glazing glass" may be used so long as it is continuous- as in sprayed or poured- installation. (not "piece-fitted"). The trench should optimally ring the entire installation, at a minimum distance of 35 to 40 feet off the perimeter of the various enclosed buildings.

Independently changeable filters 19 in automated air filter changers 20 (Figure 5,6,22) located over each air intake vent 21 are sealed into the ductwork with inflatable gaskets 22, and can be
advanced, when they are contaminated into lead shielded boxes 23 by hydraulic linear actuator mechanisms 24. The air intake vents 21 and outflow vents 25 for each dome are connected to intake dampers 26 and outflow dampers 27 with inflatable seals 28 which permit any intake or outflow to be independently opened or closed. Since the air intakes may be opened independently from the outflows, this permits all the filtration equipment to be utilized to filter the air from any combination of the air spaces 10, 11, 12, 13 at once or sequentially.

The turbine intake fans 16 each have multi-blade high-rpm impellers, with each blade "torqued" at a precise angle of 30 degrees with respect to the horizontal, at a distance 5/8 of the distance from the hub to the tip of the blade, and with a total of 32 identical blades per hub. The impeller blades are to be made of specific (provisionally classified) materials. The casing for each fan is to be approximately 15 feet in diameter, and 40 feet deep, and attached to tubular outflow 18 and inflow 17 ducts which are a minimum of 12 to 14 feet inside diameter. The casing material must be made of specific (provisionally classified) materials for the fission radiation neutralizers to work safely. The tubular outflow and inflow ducts are optimally of similar non-metallic materials.

Replacement of the "buried" European design single pass through vent-filter interfaced between the containment building and the atmosphere (Figure 4), with a design having interchangeable filters which interface the containment through a solenoid-actuated, pressure-sensor-thresholded valve into the air space under the inner dome, will improve the reliability of this system, and permit filter replacement.

Radiation detectors [e.g. models 3090-2, model 2-5001, model 2-5261, 2-5270, FH 40 F, FH 40 FT and Ram-D meters manufactured by Dosimeter Corporation [Box 42377, Cincinnati, Ohio 45242 (513) 489-8100] mounted throughout the system and monitored in the adjacent personnel decontamination and auxiliary control building 30, will permit remote control of servo-motor actuated dampers, fan systems and automated filter changers so as to optimize radiation filtering and to minimize radiation exposure to personnel. Underwater probes #5-0018 (FH Z--310) or #5-0019 (FH Z 131), interfaced to the
FH 40 F survey meter, could be utilized to measure the radioactivity of collected water within the containment building or in the subway trench system.

Figures 8A and 8B illustrate a fission particulate neutralizing generator. This entire unit, neutralizer canister, water tank and rod/pitchfork assembly must be made entirely of a specific (provisionally classified) material, or it will not work.

The base of the unit is a concrete pad on which is mounted a cylindrical water tank with a 'slot' in the top. Unto this is mounted the neutralizer 'canister' with a matching 'slot' in the bottom. The positively charged glass rod and a 'pitchfork' configuration move rapidly back and forth in the slot with the upper pitchfork and rod in the canister and the lower pitchfork in the water.

CANISTER: The canister is made of a specified (provisionally classified) material and is lined with a different specific (provisionally classified) material that is 'coordinated' to the original material used for production. The canister is a 4-foot cylinder about 9 feet long with a base slot about 5 feet long in common with the water tank. The ends of the canister are sealed to the intake and output air ducts coming from and returning to the lower main tube. (The rod moves back and forth inside the air ducts).

WATER TANK: Also made of a specific (provisionally classified material), it is about 5 feet high, 16 feet long, cylindrical, and sitting on a concrete pad. Each neutralizer can power 4 or 5 fans/generators easily. A matching slot (i.e., matching to neutralizer) in the top of the tank allows the 'pitchfork' to ride back and forth in the water.

GLASS ROD AND DOUBLE "PITCHFORK": Made of 2-inch glass rod, it rides rapidly back and forth in the slot, centered in the neutralizing canister with the bottom 'pitchfork' riding in the water below. It is positively charged (electromagnetically) forcing incoming contaminated air to follow it around its shape into the water and back up the other side to be
expelled out the other end of the canister and back into the lower main tube. As the glass rod extends out of the canister on both ends there is a minute opening around each hole in the ends of the canister that the rod rides in and this allows air intake and output to occur, given that the rod is highly charged and is moving back and forth rapidly creating a vacuum within the canister.

Now on the glide (pitchfork) assembly, that is a bit more complicated. At the mount of the canister where the glass rod enters there is only a millisecond of clearance where the shaft enters - and indeed it must be sealed. This is very important. As the rod then extends into the canister it 'intakes' contaminated air and forces it to follow the 'pitchfork' configuration entirely around and then forces the neutralized air out the other end of the canister.

The neutralizer is a separate unit with the contaminated air being fed into it by two methods (1) the vent tube (from the lower main tube) interlocks entirely with the mouth of the neutralizer and (2) the rapid movement of the (glass) shaft within the vent tube forces contaminated air to enter the neutralizer which, by the power then emitted A, causes the glass rod and pitchfork to constantly move back and forth and B causes the water to emit as steam which powers the turbines which power the fans which forces the air to move swiftly through the system.

The glide/pitchfork is of POSITIVE polarization. The liner of the tank (canister) is of NEGATIVE- and the incoming air of course is forced, or attracted to either one or the other according to its own penchant and will upon confront it opposite be forced into total neutrality.

The neutralizing glass slide/pitchfork passes swiftly to and fro through the canister and the water. As the contaminated air is forced by high electromagnetic energies of a negative polarization to pass over and around the glass slide/pitchfork, so the air is forced into the water which it then turns into steam ... such steam then being emitted from the tank.

The entire rod/pitchfork is moved, because of created vacuum, to travel to and fro. It will 'leap' back to fill the vacuum. It 'leaps' forward
once the charge is neutralized because of the opposite electrical polarity of the incoming air.

Figure 9 is a schematic diagram illustrating in a simplified manner some electrical features of the neutralizing generator (provisionally classified).

"Power drive" to the rod and pitchfork is attached to the 'incoming' end of the rod. Right - where the 'dirty' air comes in. This would be no more than a circuit that attaches to the end of the rod.

To seal the wires - and rod - in the air shaft, you can use any number of seals. For example, the shrouded wire conduit through a hole and seal it with grommets or washers. The conduit is shrouded with a "high tech" polymer insulating coating.

Figure 14 is a simplified schematic diagram in elevation showing some features of the general layout of the subway system with the fissile isotope neutralizers installed (provisionally classified).

This is a 'cut-away' layout of the entire installation in the subway. It is not to scale and should be seen as encircling the entire subway.

The fan shafts are powered by the turbine generators and turn clockwise. The star denotes a gear assembly allowing the 'cam shafts' to be driven by the fan shaft. Shaft/lobe material is constructed of a specific (provisionally classified) material.

'Cam shafts' are not shown complete each is approximately 40 feet long and with three lobes spaced at about 10 feet apart and contiguous with the vent tubes leading out of the main tubes. Spacing of the vent tubes is 'staggered' between the upper and lower main tubes so there must be a 'spacing' as well as size difference between the cam shafts for the upper and lower tubes. (See Cam-shaft/Lobe Blowup of Figures 10A, 10B, 11, 12 and 13.)

Each neutralizer returns air into the lower tube for re-processing and lower tube may be cut off from upper tube via shut-off valves at the ends of the vent pipes.
Details of fans and blades all seen in Figures 14 and 15.

A blow-up of the neutralizer is shown in Figures 8, 9 and 19. Collection containers may be substituted for neutralizers but would require a separate power source to turn fans and 'cam-shafts'. This would be necessary anyway, of course, and turbo-generators are suggested. It is very important that all collection and/or neutralizing operations be done underground. Explosion is possible and this would of course destroy any 'above-ground' operations or attempted containment. Attempts to build this device without knowledge of the precise reasoning behind the precisely specified (provisionally classified) materials for each component would be most hazardous.

Figures 16, 17 and 18 illustrate alternative dome enclosure designs. There are two alternative methods of enclosing the space surrounding any nuclear installation in addition to the multiple inflated dome already specified.

One of these is the structuring of a girder "skeleton tent" comprised of 16 girders forming a tent configuration, anchored into an underground base and locking into a central hub over the plant. (See Figures 16 and 17.) The upper part of the "skeleton tent" are permanently covered, and the "tent sides" are permanently installed with 'lap-folded' or 'roller mounted', ready to drop into place at any sign of trouble. The "tent sides" ride in channels in the sides of the girders and would drop into a cement trench below ground level at the base, thus enclosing any 'tainted' air entirely until the intake fans surrounding the perimeter can pull it all into the underground cleaning system. A (shrouded) intake fan mounted in the central hub may be used to pull clean air into the "tent" whenever that becomes appropriate. This system would probably be just slightly more costly than the multiple inflated dome system, but would not require continual air pressurization.

Alternative Dome Design #2 illustrated in Figure 18 would be far more costly for initial installation but has the advantage by virtue of its
corrugated design - and in conjunction with the underground fan system - to withstand atomic explosion, rather than just leakage, should explosion occur. The basis of this design incorporated three things that allow it to withstand explosion: (1) the corrugated structure, (2) the flexible high-tensile special formula aluminum the corrugated doors and dome are made of, and (3) the special 'loose structuring' of the dome as well as the ample extension of the doors underground and unto the rollers. However, without the full and maximum functioning of the fan system, causing explosion to become implosion, this structure will not withstand explosion of any major proportion. The girder structure must be made of the same special formula aluminum which will allow the girders also to "flex" by virtue of its extremely high tensile and structural strength compared to width.

The girders of Alternative Dome Design #2 (figure 18) could initially be stacked together and housed on one side of the circular trench subway system. These could be erected on command by electric or hydraulic drives which would rotate the entire stack of ribs by 90 degrees, and then radially spread the individual girders so as to provide a top view similar to that seen in the prior illustration of the top view of Alternative Dome Design #1 (figure 17). The radial spreading of the individual girders could be effected by mounting their base ends in the trolleys of a track monorail system along the outer wall of the circular trench subway system, with a chain drive connecting the trolleys. There are several possible hinge designs for the apex of these girders, which could for the sake of argument, be interlocked into a series of concentric circular tracks located inside or outside the girders at the apex in a similar (but undriven) track monorail as that used at the base. An apical fan could optionally be mounted in an upper, inner circular track, if desired.

The triangular slam doors would be preferentially be corrugated with a single proprietary, unique, specific, theoretically optimal and provisionally classified computer derived corrugation pattern. Although multiple other types of corrugations were considered in arriving at this design, (and may have application for
domes where maximal strength and detonation resistance are not considerations) these are not preferred embodiments for the present application. This corrugation pattern, the shape of the ribs, the exact details of the seals, the method of sealing the bases and edges of various dome designs, and the precise composition of the ultra high-strength alloys involved are so scientifically optimized that at this point the inventors feel they cannot be substantially improved upon, and these are likewise protected by trade secrets and are provisionally classified pending military evaluation.

In one of several possible drive schemes, the slam doors are advanced in pairs into the rib girder skeleton by hydraulic or chain drives housed in a "drive rib", and the free edges of these pairs approximate and then enter the seal tracks of adjacent "seal ribs" whereupon all of the rib seals are contracted as described below to form hermetic edge seals. The advance of the slam door vertically upward from a horizontally mounted spool in the track subway system is perfectly analogous to existing well-described "rollerdam" technology.

In both alternative dome designs, hydraulically or electrically driven eccentric cams or ball screw drives can be utilized to tighten seals within the girder tracks to effect a hermetic seal with either the lap folded curtains (in Alternate Dome Design #1) or the high tensile strength special alloy "slam doors" (in Alternate Dome Design #2). In the case of the edges of the "slam doors", illustrated in the inset in figure 18 is a (silicone-lubricated) compressible seal which could, over a distance of 3 to 4 inches, be glued to the edge of the triangular "slam door" and which could be advanced into a similarly shaped track composed of two metal "C" shaped edges. These "C" shaped metal girder edges of the tracks could be approximated to compress the seals by the aforementioned eccentric cams or by motor driven levers or screws. The triangular slam doors themselves could be advanced in pairs with "driven" edge seals in tracks containing a chain or hydraulic drive to lift the door to the apex, and with the free edge seals slamming into a somewhat more "open 'C' track" which
could be closed by similar cam, lever, or screw actuators when the
door is advanced to its fully closed position.

In any given installation, it is likely that a combination of one
or more dome technologies could be potentially advantageous. The
rigid slam dome, Alternate Dome Design #1 or a rigid pre-installed
geodesic dome could for example be surrounded by a series of
concentric inflatable domes, or if the site does not permit, could be
connected via an over-flow filter and underground channel to an
remote expansible dome section.

**Notice and Warning**

The inventions described herein are the culmination of tens of
thousands of man-hours of research, costing hundreds of thousands
of dollars, and have deliberately not been entirely described in the
ultimate ideal embodiments at this time for reasons noted above.
The inventors broadly claim as totally unique, novel and basic to the
present invention: the design of domes which erect themselves via
automated drives from underground trenches, the expanding plastic
barrier device, the circular trench subway radioactive liquid
reservoir/cyclotronic containment system, the automated filter
changers, the ferrous chelation/magnetic filtration of ionic chemical
and radioactive wastes the various designs for concentric inflatable
domes interfaced to air filtration systems, and the application of all
of the above to containment, filtration and neutralization of
radioactive and chemical, air-borne and liquid wastes. The fission
radiation neutralizer represents a wholly new technology which shall
permit the safe neutralization and disposal of radioactive wastes. It
absolutely cannot be constructed from the sparse details contained
herein, and any foolish enough to attempt to do so without a
complete understanding of its design are here forewarned: Unless
the *precisely correct* (provisionally classified) materials are
utilized throughout, it will certainly not work and could very easily
self destruct in an atomic explosion, releasing the very isotopes
which a correctly constructed device is intended to neutralize.

Although the details described herein are enabling to construct
some aspects of these designs, for reasons of National Security of the
United States of America, certain critical details and additional aspects of several parts of this invention have been intentionally deleted from this PCT application. Contractors, countries, and individuals wishing to participate in the implementation of any of these devices by purchase of licensure rights shall be given access to this proprietary information only after the signing of appropriate non-disclosure agreements. The inventors wish to encourage rapid worldwide implementation of this invention so as to prevent potential catastrophic environmental destruction, and will license the technologies described herein to contractors in any country on a competitive basis. The technologies which are "provisionally classified" will be licensed and shared with contractors upon approval of the United States Department of State, or branch of government designated by the Executive Office of the White House, after suitable application has been made to the inventors to justify granting these rights.

Substantial portions of the earnings of these inventions shall be donated to medical research. "Robber Barons" intent on profiteering by misappropriating aspects of these inventions without paying royalties will deprive deserving patients of these funds and are all now forewarned that they shall answer for any patent infringement in courts of law in vigorously prosecuted civil and class actions. Any party wishing to contribute improvements to the present invention or which can speed its implementation via a contribution or construction of a critical component, shall be justly compensated if they indeed improve the invention or facilitate the inventors' goals for rapid worldwide implementation without violation of the patent rights claimed herein. Such parties, and contractors wishing to purchase licensure rights are encouraged to write the inventors directly at our parent company:

Auxiliary Inflatable Containments Incorporated (AiCi)  
Suite 2700, 1340 West Irving Park Road  
Chicago, Illinois 60613  

peace.
CLAIMS:

1. A method of and a structure for physically containing radioactive gasses and airborne particles escaping from a Nuclear Power Plant during an accident in which the containment building has failed. This structure could be erected during an accident or in an emergency such as an earthquake but would preferentially be erected before an accident occurs. Said method and structure would create an auxiliary inflatable containment building peripheral to the existing structure consisting of the following elements:

   A. A multilayered and expandable covering structure secured to the ground in a manner that provides a relatively airtight seal. Said structure to be made of fire retardant materials.

   B. A recirculating air filtration system in which the air under said covering system is circulated through a system of filters, including but not limited to a High Efficiency Particulate Airborne (HEPA) particle filter, an activated charcoal filter, an electrostatic filter and possibly a liquid phase "scrubber".

   C. A set of detectors within said inflatable and expandable covering system to assess the spatial location and concentrations or
activity of the said sources of radioactive gases.

D. An expandable "bellows" section of said inflatable structure in applications such as Nuclear Power Plant protection, where said escaping radioactive and toxic gases may also be heated, requiring additional volume for containment until said gases have been rendered harmless by said containment system. In this application, an additional emergency over-pressurization single pass-through filter could be provided to permit hot gases contained under said inflatable containment structure to be more safety vented to the outside in the event that the volume of said expandable bellows section is completely filled with heated gases.

2. A method of exchanging said filters within said filtration system which automatically replaces contaminated filters with fresh ones or which effects such replacement by remote control.

3. A method of detecting and the contamination of said filters which is externally monitored to provide information on filtration efficiency and prediction of when said filters should be changed. In the case of the nuclear power plant protective device, this could be determined, for example, by Geiger counters or by more sophisticated radiation detectors such as those having energy
resolution (using a crystal and a multi-channel analyzer), to quantify the exact type and quantity of various trapped radionuclides for the purpose of prediction of filter capacity. The placement of monitoring apparatus in various locations within the system will permit the detection and measurement of filtration efficiency.

4. A method of evaluating said multi-layered inflatable covering and containment system for leaks, consisting of detectors (such as Geiger counters) measuring the radioactivity between the multiple layers of the inflated structure. In the case of the preferred embodiment of said inflatable structure (which is of the design built by Environmental Structures Incorporated of Cleveland, Ohio), these monitoring devices would monitor the gases passing through individual parallel tubular channels (between support wires) which would permit localization of any rupture or breach of the inner layer of an individual channel to permit patching or repair before the outer layer is damaged.

5. A method of providing safe escape routes for personnel working in the building under said inflatable structure consisting of separate pressurized escape pathways whose pressure is maintained by fans and a monitoring system to be greater than the air pressure under said inflatable structure. This escape pathway to be interfaced to the outer environment by a set of "air locks" and possibly attached to a building or structure containing decontamination showers.

6. The application of the present invention to capture gasses escaping from other sources of radioactive gasses such as Radon released from Uranium
mill tailings, and other biologically toxic gasses released from radioactive and chemical waste dumps and chemical plants.

7. An apparatus for containment and treatment of dangerous airborne contaminants comprising:
   a) an inflatable containment structure secured to the ground in an airtight manner and covering a site posing the potential of release of airborne contaminants;
   b) a recirculating air filtration system connected to said containment structure for recirculating air in said containment structure; and
   c) filtration means for removing airborne contaminants from air recirculated through said recirculating system.

8. The apparatus of Claim 7 wherein the site covered is a nuclear power reactor containment building.

9. The apparatus of Claim 7 wherein the site covered poses potential release of toxic chemicals.

10. The apparatus of Claim 8 further comprising a set of radiation detectors inside said structure to assess the spatial location and concentration of radioactive contaminants.

11. The apparatus of Claim 8 further comprising an expandable section for accepting increased volumes of gases in an emergency situation.

12. The apparatus of Claim 8 further comprising an emergency over-pressurization high efficiency single pass through filter.
13. The apparatus of Claim 7 wherein the structure is made of fire retardant materials.

14. The apparatus of Claim 7 wherein the filtration means comprises one or more filter mechanisms selected from the group consisting of high efficiency particulate airborne particle filter, electrostatic filter, activated charcoal filter and liquid phase scrubber.

15. The apparatus of Claim 7 wherein the inflatable structure comprises a multilayered covering having steel cables encased in seams between layers and tubular channels between seams.

16. The apparatus of Claim 15 further comprising contamination sensors for monitoring contamination in gases inside said tubular channels to determine the existence of leaks in the layers of the inflatable structure.

17. The apparatus of Claim 7 wherein the filtration means comprises filter cartridges for trapping radioactive airborne contaminants and wherein the apparatus further comprises means for automatically moving contaminant loaded cartridges into a shielded position and replacing such cartridges with fresh cartridges.
18. The apparatus of claim 8, 9, 10, 11, 12, as modified by the replacement of the inflatable dome designs with the alternate dome designs described in figures 16, 17, and 18.

19. The apparatus of claim 17 wherein said filter cartridges are advanced from an underground subway system into an automated filter changer wherein air flow through said cartridges is sealed via inflatable seals as shown in figure 20.

20. The apparatus of claim 19 wherein used cartridges are advanced by a chain drive, tape drive or linear actuator into position for active filtration, and then further advanced into a shielded box (possibly underground) for discharge.

21. The method of claim 5 wherein the escape pathway consists of an underground tunnel pressurized by independently powered air and hoses compressor and fans, and wherein air locks appended to internal control building permit workers in radiation suits (or robots) to access ground equipment including the reactor containment buildings, attached to a source of externally filtered air.

22. The apparatus of claim 5 wherein there are multiplicity of concentric domes of increasingly larger volumes, to filter overpressure gases.

23. The apparatus of figures 5, 6, 7, 16, 17, 18, wherein a underground circular trench subway made of prestressed reinforced concrete interiorly lined with glass serves also as an underground housing for fans, filters and as an over-flow reservoir for radioactive liquids.

24. The apparatus of claim 23 wherein the circular trench subway system also houses a synchrotron.

25. The apparatus of claim 23 wherein the circular trench subway system also houses the track monorail system and corrugated triangular slam doors of alternate dome design #2, (figures 18).
The apparatus of claim 23 wherein the circular trench subway system also houses lead shielded superconducting magnet trap for ferrous chelation/magnetic filtration of ionic chemical and radioactive wastes.

The filtration method of claim 26 is claimed as unique and novel to the present invention and is not limited to the circular trench subway system.

The design of a plastic pocket expanding barrier for the isolation of radiochemicals from lakes and rivers. Said expanding barrier is described with alternate embodiments of freely moving or hermetically sealed distal edges.

Alternative dome design #2, depicted in figure 18 wherein a series of rigid corrugated dome sections priorly fitted to a multi-rib superstructure and hydraulic drive, arise on command from the circular subway to form a dome entirely enclosing the station.

Alternate dome design #1 as depicted in figures 16 and 17 and described in the text.

The automated deployment of an accordion folded, multilayer inflatable dome from a trench, over a series of "ribs" (as a shower curtain slides on a rod), to form a series of concentric domes which enclose the entire structure and seal it circumferentially to the ground in communication with an air filtration and fissile product neutralization system.

The fissile product neutralization system and fission neutralization generator described briefly in the specification and depicted in figures 8, 11, 12, 13, and 15, and its interface alternate dome design #2 as depicted in figure 18.
Figure 1

LARGE VOLUME PRESSURIZED WATER CONTAINMENT

CONTAINMENT HEAT REMOVAL

CONTAINMENT WATER SPRAY

CONTAINMENT AIR COOLING & FILTERING

PRIMARY COOLANT PUMP

PRIMARY SECONDARY HEAT EXCHANGER

ISOLATION VALVES

REINFORCED CONCRETE

GRADE

CORE COOLANT SAFETY INJECTION
This is a series of "cam-shafts" whose lobes are congruent with the air egress vents in both the upper and lower main tubes encircling the subway. Their function is 'open and close' vent openings in a synchronous continuum to control air egress. Each shaft is approx. 45 feet long (varies) with lobes spaced approx. 10 feet apart contiguous with vents. Each shaft has a series of 3 lobes which is a continuous repeating pattern. Shafts are driven from the fan shaft and MUST be glass or carborundum.
SECTIONAL OF SUBWAY

SHOWS APPROX. 80 FEET IN ROUGH PROPORTION
skeleton" over plant has permanent cover over top while "tent sides" are installed "lap-folded", ready to drop in case of emergency. Side channels in sides of girders and may be raised (hydraulically) again up. (Shrouded) intake fan in top hub can be opened for (clean) air suction fans around base perimeter pull "tainted" air into underground tank.

Shrouded intake fan mounted in hub
Girder "skeleton framing"
Lap-folded "tent sides"
Intake to underground clean-up system above-ground suction fans

" is shown round, but shape may be adapted to any installation, by changing uration of the girders. Tent should be installed approximately 30 to 40 feet
erimeters of the plant.

Girder skeleton mounted over plant has permanent cover. Top girders are angled for run-off.

Lap-folded panels drop to below ground level between girder/ir.

Suction fans to underground clean-up system pull in tainted air.

shows permanently covered girder skeleton installed over power plant. Powerful d) intake fan is mounted in center hub and suction fans leading to the under-

ley clean-up system ring the interior base perimeter. Lap-folded sides are around top perimeter ready to drop in place at any emergency.
ALTERNATE DOME DESIGN #2

- GIRDERS

GIRDER STRUCTURE SUPPORTS SLAM-DOORS AND PERMANENT DOME.

GROUND LEVEL

UNDERGROUND CLEAN-UP SYSTEM - ABOVE GROUND SECTION FANS

PERMANENT "CORRUGATED" DOME INSTALLATION IS "LOOSE" OVER GIRDER FRAMING.

DOORS "SLAM-CLOSE" (ONLY) TO HORIZONTAL, GIRDER 'HUB' STRUCTURE DOME ABOVE IS PERMANENT.

CORRUGATED ALUMINIUM "SLAM DOORS"

CORRUGATED DOORS ARE HYDRAULICALLY CLOSED AND OPENED FROM UNDERGROUND ROLLERS; RIDING IN TRACKS IN SIDES OF GIRDERS. DOORS STAY CORRUGATED WHEN CLOSED AND "TOP SEAL" IS STRONGEST POINT WHEN CLOSED.

CROSS SECTION OF RIB SEALS

[Diagram showing cross section with labels for right edge of slamdoor A, left edge of slamdoor B, and 'seal' track of rib]
Figure 21

- A recirculating high volume air filtration system with a HEPA high efficiency particulate air filter followed by an activated charcoal scrubber and fan.
- System equipped with an automated filter changer, which replaces the contaminated filter into a lead box and replaces it automatically with a fresh one.

Fresh Filter
Storage unit

Filtering unit

Lead box
Containment unit
for the storage and removal of used filters

On Site Monitor
INTERNATIONAL SEARCH REPORT

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols appear, indicate all) *
According to International Patent Classification (IPC) or to both National Classification and IPC

IPC*: G 21 C 9/00, 13/00, G 21 F 7/00, 3/00

II. FIELDS SEARCHED

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched *

III. DOCUMENTS CONSIDERED TO BE RELEVANT *

<table>
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<tr>
<th>Category</th>
<th>Citation of Document, with indication, where appropriate, of the relevant passages</th>
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* Special categories of cited documents: 10
**A** document defining the general state of the art which is not considered to be of particular relevance
**E** earlier document but published on or after the international filing date
**L** document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
**O** document referring to an oral disclosure, use, exhibition or other means
**P** document published prior to the international filing date but later than the priority date claimed
**T** later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
**X** document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step
**Y** document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
**A** document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search: 15th February 1991
Date of Mailing of this International Search Report: 15.10.91

International Searching Authority: EUROPEAN PATENT OFFICE

Signature of Authorized Officer: [Signature]
FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

| A | DE, A, 2921944 (MARX) | 1,6-9,13,23,32 |
|   | 11 December 1980 |   |
|   | see page 2; figure |   |
| A | WO, A, 8404226 (FEDOROWICZ) | 1,6-9,13,15,31 |
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| A | FR, A, 1566305 (FABRIQUE DE SOIERIES) | 1,5,7,21,31 |
|   | 9 May 1969 |   |
|   | see the whole document |   |

V. OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. Claim numbers 1-27, 29-32, because they relate to subject matter not required to be searched by this Authority, namely:

2. Claim numbers 1-27, 29-32, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claim numbers 1-27, 29-32, because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

This International Searching Authority found multiple inventions in this international application as follows:

1. Claims 1-27, 29-32

2. Claims 28

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers: Claims 1-27, 29-32

4. As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remainder of page

Form PCT/ISA/210 (supplemental sheet 2) (January 1985)
ANNEX TO THE INTERNATIONAL SEARCH REPORT 
ON INTERNATIONAL PATENT APPLICATION NO. US 9004690 
SA 41922

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 03/09/91. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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For more details about this annex: see Official Journal of the European Patent Office, No. 12/82