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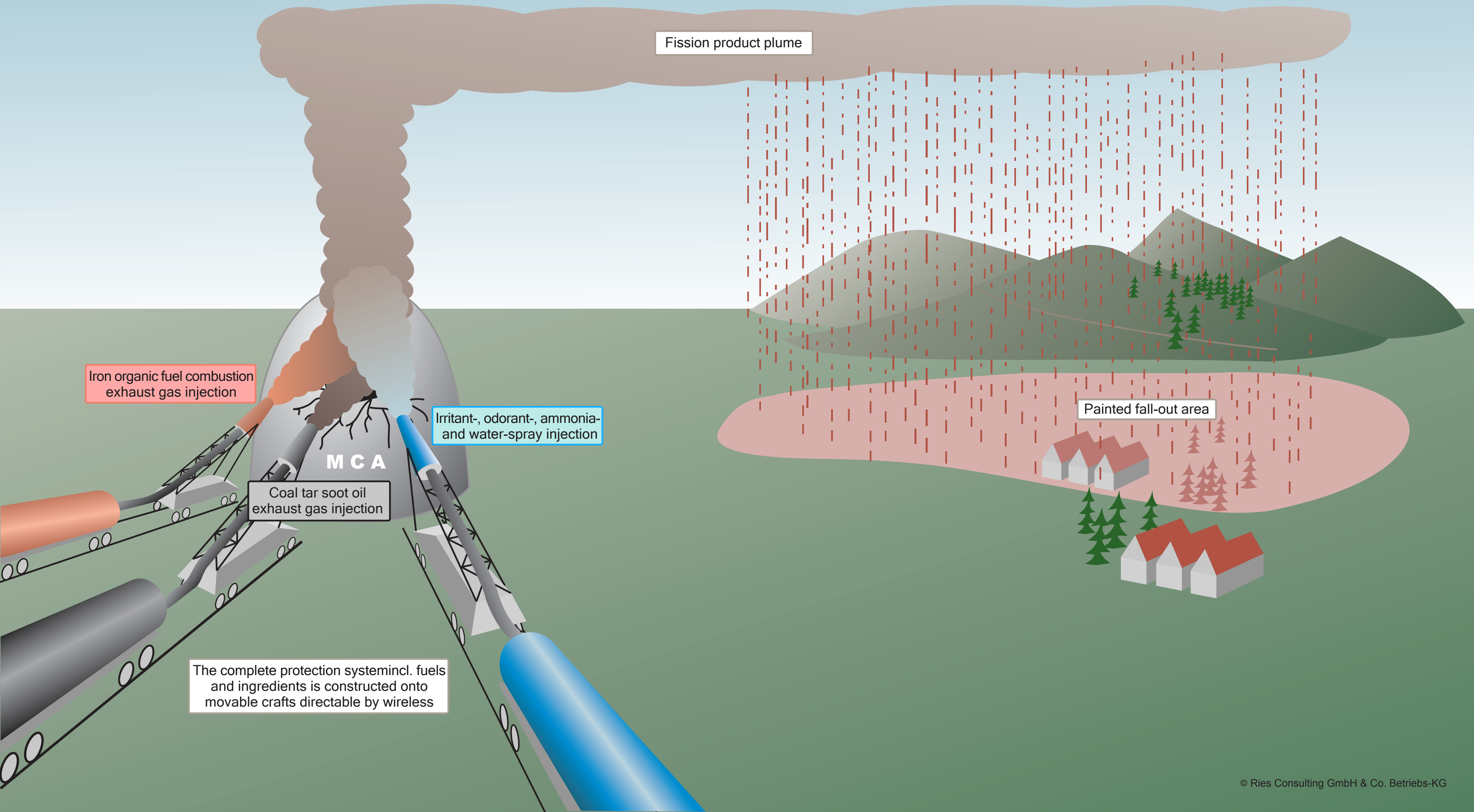
MCA Fallout Protection System
at nuclear power plants
exemplary description



Nuclear Plant Protection System to Minimize MCA Fallout Hazards by Pigment Injection into the Radioactive Cloud

(international patents applied)

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INTRODUCTION AND PROBLEM DESCRIPTION

The proposed protection system for nuclear plants bases on known principles of particle agglomeration, sorption and chemical reaction, permitting the growth of ultra-fine particles to millimeter-size particle agglomerates upon release to the atmosphere.

While design and functions of protective installations in today's nuclear plants are tailored to exclusively handle such failures and incidents as may occur under the individual facility's regular operation, none of them is prepared to adequately cope with externally induced accidents. The same restriction applies likewise to the regular training of the workforce in charge of operation by restricting the assumed worst-case scenario to plant internal breakdown events.

Regarding the escalation of terrorist attacks in the past decade culminating in the WTC disaster, it is not at all unthinkable that a nuclear power plant might well be chosen for the next target. Not less vulnerable than the WTC, the intended MCA were to 'promise' a death toll far outnambering the innocent victims of September 11th. Not only the latent threat of terrorism raise the call for new protective systems, while the Harrisburg luckily evaded the Chernobyl disaster has shown, MCA's do happen in spite of in account; though unable to stop the core melting process once it has begun, the remaining objective is to lessen the hazards radiating from the radioactive fission products containing plume to the least possible minimum.

PROBLEM SOLUTION

In our patent application we propose to inject iodine and soot pigments (Table 1), hygroscopic agglomerants (Table 2), irritants and odorants (Table 3), into the radioactive fission products emitting plume source at the ground or only meters above it. The soot pigments serve to sorb the different fission products: Carbon soot adsorbs the radioactive jodine isotopes and radioactive noble gas compounds; iron oxide soot adsorbs and absorbs the different radioactive heavy metal compounds. Additionally, the pigments reactive, adsorptive and adhesive properties will carry the agglomerant precursors, odorants and irritants by adsorption and adheration. Additionally the soot pigment carriers will catalyze agglomerant creation and shield the odorants and irritants against photolytic decomposition.

Soot pigments, along with thermo stable agglomerants and agglomerant precursors may be produced by combustion by commercial oil burners. The ejected combustion exhaust gas flow is injected into the plumes source or as close as possible above it. To avoid thermal decomposition of the temperature sensitive ingredients, certain agglomerant precursors, odorants and irritants ought to be injected as spray into the plume by blowing irritant and water spray mist into the plume. The arrangement of the principal elements of the invention are represented exemlary in Picture 1 and flow sheet 1.

According to their outstanding properties (sorptive and catalytic power, deep pigment colouration and stability against dissolution around neutral pH-environment) the pigments preferred are carbon soot and iron oxide soot. Preferable both soot pigments are generated by combustion with separate oil burners. Nebulizing high quantities of water into the plume will cool the plume in order to decrease its buoyancy. Commercial liquid nebulizers known as 'snow canons' may be used for this purpose. Both, burner and nebulizer equipments are arranged separate movable and navigatable and may be directed wireless by radio control. The burners and nebulizers incl. vessels containing the liquids are arranged movable and navigatable on railway crafts, tracklaying crafts, or other offroad crafts directable wireless as well.

Iron oxide soot is produced by combustion of mineral oil mixtures preferable with iron organic content (e.g. ferrocene) of more than 10 %. The oil mixture may be combusted at oxygen exess conditions. Combusting at oxygen deficient conditions addition of sulfur compounds to the fuel will catalyze the further iron oxidation of soots containing iron in a lower oxidant state. Carbon soot may be produced by combustion of coal tar soot oil containing hygroscopics precursors, e.g. zinc organics, tetrachloro ethylene and carbon disulfide; jodine precursors, e.g. tetraiodo ethylene. In order to optimize the carbon soot yield, the soot oil combustion has to be processed at oxygen deficient conditions. Addition of temperature sensitives to the plume, e.g. the hygroscopics precursor ammonia, the odorant skatole and the irritant dibenz-1,4-oxazepine, may be arranged like follows: A liquid mixture of the odorant and irritant in acetone, the hygroscopics precursor as solution in water and a large excess quantity of water are nebulized in a snow canon and blown into the plume as far as possible above the plume source. Flow sheet 1 gives a schematic and exemplarous overview about the effects working.

In the rising and cooling cloud, the created agglomerant pigment coating components zinc chloride, zinc sulfate, ammonium hydrogen sulfate and ammonium sulfate induce both, water condensation and the agglomeration of solid

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particles even under conditions of low humidity. This results in growing particle diameters and accelerates the precipitation in the shape of particle containing drops or in the shape of particle agglomerates. Touching the ground drops and particle agglomerates will paint all wettened surfaces by the soot pigments. Because of the odor- and irritant load of the soot pigments the coloured surfaces are marked also by an repellent odor and smell, warning humans and animals alike to avoid any contact with the coloured surfaces.

Owing to the soot pigments agglomerant and hygroscopic properties accelerating fallout precipitation, the fallout area is shrunk by a manyfold comparing to the untreated plume fallout area.

Because irritants and odorants keep adsorbed on the soot pigments, they are protected against decomposing actions of photo oxidation. Tight adsorption of the fission products on the soot pigments, keeps groundwater protected from contamination. Using oxidant- and hydrolysis-resistant irritants and odorants as marker, repellant effects of the fallout may hold on for months. Even if strong adsorption forces holds the repellants tight to the soot, sorption- / desorption- balance of sorbent- / repellant- / fluid-system will keep enough repellant molecules in the surrounding fluid detectable to nose, tongue or mucous skin. Rain may wash away parts of the fallout into drains; but sediment-colour and the repellent odor bound to the soot pigments are indicators helping to detect their sediments.

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Table 1

Exemplary soot pigments for MCA fallout protection

Soot pigment	Soot pigment precursor	Soot pigment colour
Carbon soot	Coal tar oils	black
Iron oxide soot	Iron organics	red
Manganese oxide soot	Manganese organics	brown
Titanium oxide soot	Titanium organics	reflecting white
Silicon oxide soot	Silicon organics	white

Table 2

Exemplary hygroscopics for MCA fallout protection

Hygroscopic substances	Precursors
Sulfuric acid	Sulfur, sulfur dioxide, sulfur organics, hydrogen sulfide, carbon disulfide
Ortho phosphoric acid	Phosphorus, phosphorus organics, phosphine
Zinc chloride	Zinc metal & halogene organics, zinc organics & halogene organics
Ammonium chloride	Sulfur dichloride & ammonia, halogene organics & ammonia
	Sulfur dioxide & ammonia, hydrogen sulfide & ammonia

Table 3

Exemplary odorants and irritants for MCA fallout protection

Odorants	Irritants
Pyridine	Chloro acetophenone
Ethane thiol	Dibenz-1,4-oxazepine
Vanilline	Chloro pikrine
Ionone	Pelargonic acid morpholide
Butyric acid	
Skatole	

Exemplary MCA fallout protection system at nuclear power plants

- Minimizing fallout area by loading fission product plume with coloured soot pigments and hygroscopics
- Signalling the fallout area by charging the fall out with coloured soot pigments, odorants and irritants
- Charging the fallout with protection aid against radioactive iodine uptake