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⑤④ **Decontamination method.**

⑤⑦ A method of decontaminating radioactive components by subjecting the components to a water jet.

The high pressure water jet contains 3 to 7% in weight abrasive grits for removing a radioactive oxide film from the surface of the components.

The method provides a means by which components used in nuclear power plants may be decontaminated so that working personnel may inspect or repair the components without excessive radiation exposure.

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DECONTAMINATION METHOD

This invention relates to decontamination methods and more particularly to methods for decontaminating components of nuclear power plants.

During the operation of nuclear power plants and
5 similar apparatus, certain components become exposed to radiation and may develop a thin radioactive film on the surface of the component. From time to time, it is necessary to either inspect or repair these components of the nuclear reactor power plant. During the inspection or
10 repair of the components, it is necessary for working personnel to enter the component or to be stationed in close proximity to the component whereby working personnel may be exposed to radiation emitted from the contaminated component. In some circumstances, the radiation field
15 emitted from these components is such that a worker would receive the maximum permissible radiation dose in less than five minutes of working time. Such a situation means that a given worker may only spend a relatively short amount of time working on the inspection or the repair
20 operation of the nuclear component. Having each worker spend a relatively short amount of time in the repair or inspection procedure, necessitates the use of many workers with each worker working a short time period in order to accomplish the desired procedure. While this may be an
25 acceptable practice for minor inspections or repair procedures, this is not an acceptable practice where there is an extensive inspection or an extensive repair job to be performed. Where the procedure to be performed is a time

consuming procedure, it is likely that an unusually large number of highly trained personnel would be necessary to carry out the task. Such a situation may not only be unacceptable from a financial aspect, but may also be
5 unacceptable from a man-power level aspect.

Therefore, it is the principal object of the present invention to provide a decontamination method that reduces the radiation field in components of nuclear reactor power plants so that working personnel may perform
10 operations thereon.

With this object in view, the present invention resides in a method of decontaminating components, especially components of nuclear power plants, wherein the components are exposed to a water jet to remove the radio-
15 active particles therefrom and, at the same time, to wash the radioactive particles away from said components without damaging the metal surface of the component characterized in that said water jet is a water-grit mixture having a grit concentration of between 3% to 7% by weight for
20 intense particle removing action.

The flow rate and pressure of the water jet are controlled so that a thin layer of metal oxide deposits may be removed from the component without damaging the metal component itself thereby reducing the radiation
25 field of the component. The grit types, size, and concentration in the water jet are also controlled along with the distance of the nozzle from the surface of the component and the angle of impingement so that an optimum level of decontamination is achieved without deterioration
30 of the metal surface.

The invention will become more apparent from the following description of a preferred embodiment thereof shown, by way of example only, in the accompanying drawing, wherein the single figure is a diagram of apparatus
35 used to perform the decontamination method.

During operation of typical nuclear power plants, certain components of the nuclear power plant such as the nuclear steam generators, become radioactively

contaminated. Since certain repair or inspection operations that must be performed periodically on the nuclear power plant components require working personnel to be present in or near the components, it is important that
5 the radiation field associated with the component be at a level that is compatible with the presence of working personnel for an extended period of time. The invention, described herein, is a method for decontaminating components of nuclear power plants so that working personnel may
10 perform operations thereon.

Referring to the drawing, apparatus for performing the decontamination method comprises a platform 10 for supporting container 12 which may be a steel drum having a closure plate 14. Container 12 comprises supports 16 for
15 supporting the specimen 18 to be decontaminated. Container 12 also has a vent 20 and a drain 22. Container 12 is arranged such that the front portion thereof is supported by a bar 24 so that container 12 is tilted such that liquid within container 12 will flow through drain 22.
20 Drain 22 is connected to filter 26 which may be a 5-25 micron filter bag chosen from those well known in the art. Filter 26 is connected to a pipe 28 which is connected to a drain for disposing of or recirculating the water used in the decontamination process. A 2.3 cm diameter tube 30
25 extends through universal joint 32 and closure plate 14 so that the front end of tube 30 is disposed within container 12. A nozzle 34 is mounted on the front end of tube 30 and is also connected to flexible hose 36. Nozzle 34 may be chosen from those well known in the art such as a
30 "Dynajector" manufactured by the Aqua-Dyne Engineering, Inc. of Houston, Texas. Flexible hose 36 extends through closure plate 14 and is connected to grit supply 38 for supplying grit to nozzle 34. Tube 30 is connected to pump 40 which may be a 40 horsepower pump which is also connected to water supply 42 for supplying water to nozzle
35 34. Nozzle 34 provides a mechanism for mixing the grit and water and for emitting the water-grit mixture from nozzle 34 toward specimen 18. Tube 30 is also attached to

drive mechanism 44 which may be a mechanism for controlling the horizontal movement of tube 30 and nozzle 34. Drive mechanism 44 may be chosen from those well known in the art.

5 The decontamination method comprises introducing water through tube 30 at a pressure between 140 kg/cm^2 and 190 kg/cm^2 . The water flow rate at this pressure should be approximately 30 to 34 liters per minute through nozzle 34. Several types of grit may be used for mixing with the
10 water such as alumina or magnetite. However, the grit size should be approximately 120 to 325 mesh size in accordance with United States Sieve Series Mesh Sizes. It is important to note that the grit concentration in the water spray should be approximately 3% to approximately 7%
15 by weight. In order to provide effective decontamination without excessive metal deterioration, it is important that the nozzle be placed approximately 15 cm to 25 cm from the surface of specimen 18. It has also been found that nozzle 34 should be arranged at approximately between
20 30° to 70° with respect to the longitudinal axis of tube 30 so that the water-grit mixture impinges the surface of specimen 18 at approximately between a 30° - 70° angle and preferably at about 45° .

OPERATION

25 In operation, a test specimen 18 having a top surface that has been contaminated with radioactivity is placed within container 12 and supported by supports 16 as shown in the drawing. Closure plate 14 is then attached to container 12 such that tube 30, nozzle 34, and flexible
30 hose 36 are arranged as shown in the drawing. Universal joint 32 which also comprises a clamping mechanism is arranged such that the flow of the water-grit mixture from nozzle 34 is directed to the proper elevation of specimen 18. At this point, nozzle 34 is approximately 15 to 25 cm
35 from the surface of the specimen 18. Next, pump 40 is activated which causes water to be pumped from water supply 42 through tube 30 and into nozzle 34. The flow of water through nozzle 34 creates a vacuum in nozzle 34

which draws the grit from grit supply 38 through flexible hose 36 where it mixes with the water in nozzle 34. The water-grit mixture is then directed toward the specimen 18. Simultaneously, drive mechanism 44 is activated which causes tube 30 and nozzle 34 to move in a horizontal line across specimen 18 at a speed of approximately 30 cm per minute to approximately 90 cm per minute. The speed of travel of nozzle 34 is correlated with the water-grit flow rate so as to provide effective decontamination without excessive deterioration of the metal of specimen 18. The water and grit mixture impinges on the surface of specimen 18 and removes a thin oxide layer from the specimen which is carried away by the water-grit mixture and drains through drain 22 into filter 26. Once nozzle 34 has made a complete horizontal pass of specimen 18, universal joint 32 is readjusted so that nozzle 34 is directed toward a different vertical elevation of specimen 18 and at the same 15 to 25 cm distance. Then, drive mechanism 44 is reversed so that nozzle 34 makes a similar horizontal pass of specimen 18 but at a different elevation. In this manner, an entire sweeping of specimen 18 may be made. In addition to the apparatus as shown in the drawing, an additional nozzle 34 may be attached to tube 30 and also arranged at approximately a 45° angle and opposing the first nozzle 34 so as to provide a dual nozzle arrangement.

A test of the decontamination method was made with the following parameters:

1. Nozzle Pressure - 170 kg/cm²
2. Water Flow Rate - 3.8 l/min/nozzle
3. Grit Types - Alumina and Magnetite
4. Grit Size - 220 mesh and 325 mesh
5. Grit Concentration in Spray - 3% to 7% by weight
6. Spray Traverse Velocity across Surface - 40 cm/min to 97 cm/min

7. Nozzle to Surface
Distance - 15 cm
8. Impingement Angle - 45°

Two passes were made across the surface of the specimen,
5 one pass each at opposing 45° angles. This ensured cleaning of both sides of the irregularities in the surface of the specimen. Results of the tests show that 98.3% to 99.9% of the radioactive contamination was removed from the sample simulating nuclear reactor component surfaces.
10 None of the samples suffered perceptible surface damage.

Tests and analysis have determined that with the use of the decontamination process, it is likely that less than 0.025 mm of metal surface will be removed from the specimen. It appears that the use of an alumina grit on
15 Inconel metal will remove a metal layer of less than 0.0051 - 0.0076 mm and that the use of a magnetite grit on stainless steel will remove a metal layer of less than 0.012 - 0.025 mm.

While the decontamination method has been described as being used in a test apparatus, the decontamination method may be used on nuclear reactor components such as nuclear steam generators with the equipment adapted to be placed within the nuclear component. Therefore, the invention provides a decontamination method for lowering
20 the radiation field of nuclear reactor power components so that working personnel may enter the component and perform operations thereon.
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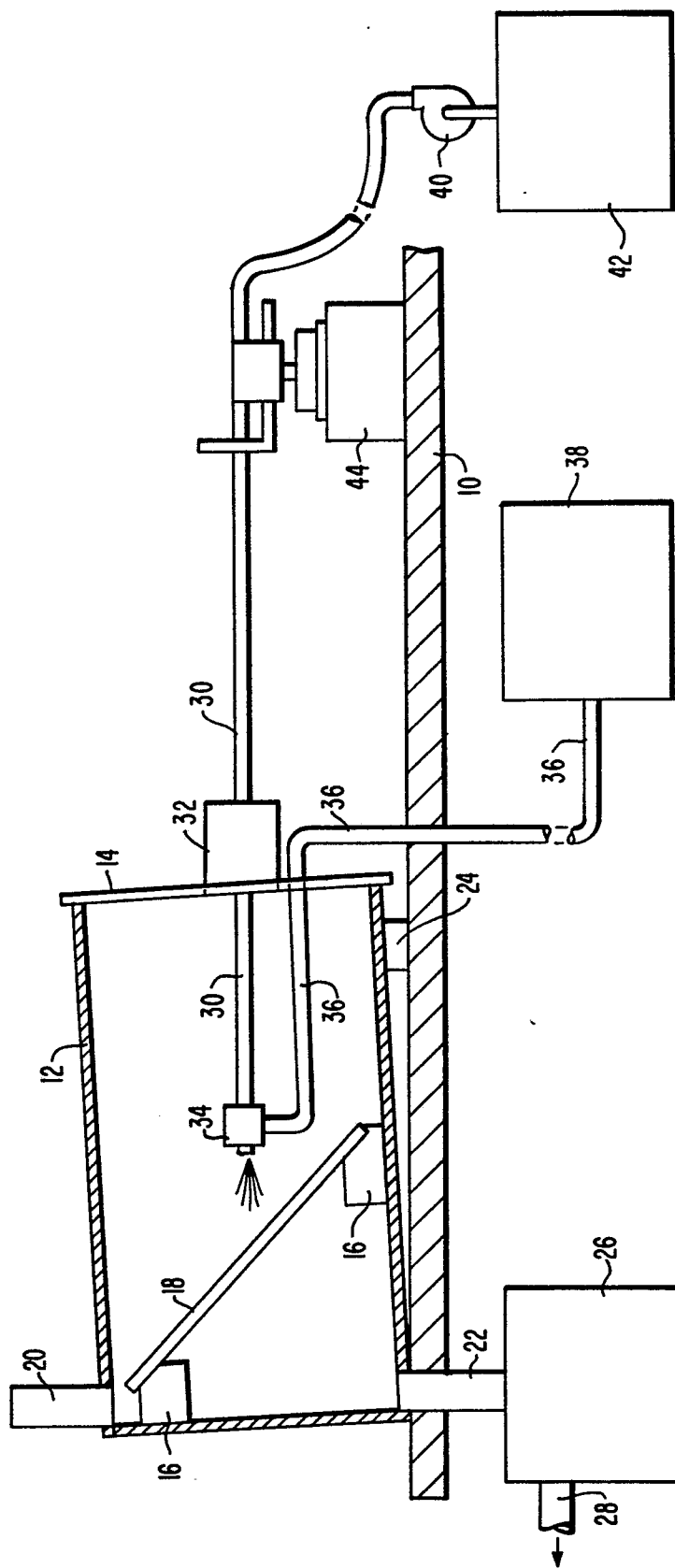
What we claim is:

1. A method of decontaminating components, especially components of nuclear power plants, wherein the components are exposed to a water jet to remove the radioactive particles therefrom and, at the same time, to wash
5 the radioactive particles away from said components without damaging the metal surface of the component characterized in that said water jet is a water-grit mixture having a grit concentration of between 3% to 7% by weight for intense particle removing action.
- 10 2. A method as claimed in claim 1, characterized in that said mixture is emitted from from a nozzle (34) which is moved along said component at a speed of 30 cm/min to 90 cm/min.
- 15 3. A method as claimed in claim 2, characterized in that said nozzle (34) is positioned at a distance of 15 cm to 25 cm from the surface of said component (18).
4. A method as claimed in claim 1, 2 or 3, characterized in that said mixture is discharged with an angle of impingement of between 30° and 70°.
- 20 5. A method as claimed in claim 4, characterized in that said mixture is discharged with an angle of impingement of approximately 45°.
6. A method as claimed in any of claims 1 to 5, characterized in that said grits have a size of between
25 120 mesh (about 125 micron sieve opening) to 325 mesh (44 micron sieve opening).
7. A method as claimed in any of claims 1 to 6, characterized in that said water-grit mixture is emitted

at a pressure of between 140 kg/cm^2 to 190 kg/cm^2 and at a rate of between approximately 30-34 liter/min per nozzle.

8. A method as claimed in any of claims 1 to 7, characterized in that said grit is alumina.

5 9. A method as claimed in any of claims 1 to 7, characterized in that said grit is magnetite.





DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ¹)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	EUR 5186 d; Europäische Atomgemeinschaft-EURATOM. 1968 MOSSELMANS G. and NIENHAUS J.: "Auswahl von Abrasiven und Bad- zusätzen für die Dekontaminierung mittels Schlammstrahlen". * Abstract; pages 5-8; pages 17-20 * --	1,4,5, 6,8	G 21 F 9/00 B 24 C 1/00
A	FR - A - 2 127 021 (SIEMENS) * Claim 1 * ----	1	TECHNICAL FIELDS SEARCHED (Int.Cl. ¹) G 21 F 9/00 9/28 B 24 C 1/00
			CATEGORY OF CITED DOCUMENTS X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
☒ The present search report has been drawn up for all claims			& member of the same patent family, corresponding document
Place of search The Hague		Date of completion of the search 29-05-1980	Examiner NICOLAS