0.001 = conversion from millirem to rem.

P_d = exposed population in region d.

Δt_ℓ = the length of the ℓth time period over which $C_{i\ell}$ and F_ℓ are averaged for all liquid releases, in hours.

$C_{i\ell}$ = the average concentration of radionuclide, 'i', in undiluted liquid effluent during time period Δt_ℓ from any liquid release, in μCi/ml.

F_ℓ = the near field average dilution factor for $C_{i\ell}$ during any liquid effluent release where:

$$F_\ell = \frac{f\sigma}{F + f}$$

where:

σ = recirculation factor at equilibrium

f = liquid radwaste flow, in gpm

F = dilution flow, in gpm.

$A_{ai\tau}$ = the site related ingestion dose commitment factor for an individual of age group, a, to the total body or any organ, τ, for each identified principal gamma and beta emitter, mrem/hr per μCi/ml.

$$A_{ai\tau} = 1.14E5\ (U_{aw}/D_w + U_{aF}BF_i)DF_{ai\tau}$$

where:

1.14E5 = 10^6pCi/μCi x 10^3 ml/kg ÷ 8760 hr/yr.

U_{aw} = water consumption by age group, ℓ/yr.

infant	0
child	260
teen	260
adult	370

D_w = dilution factor from the near field area to the potable water intake.

U_{aF} = fish consumption by age group, kg/yr.

infant	0
child	2.2
teen	5.2
adult	6.9

BF_i = bioaccumulation factor for radionuclide, i, in fish, pCi/kg per pCi/ℓ, from Table 3.1-1.

$DF_{ai\tau}$ = dose conversion factor for radionuclide, i, by age group in pre-selected organ, τ, in mrem/pCi, from Tables 3.1-2, 3.1-3, 3.1-4, and 3.1-5, respectively.

TABLE 3.1-1*
(1 of 1)

BIOACCUMULATION FACTORS TO BE USED IN THE ABSENCE OF SITE-SPECIFIC DATA
(pCi/kg per pCi/liter)

ELEMENT	FRESHWATER FISH	FRESHWATER INVERTEBRATE
H	9.0E-01	9.0E-01
C	4.6E-03	9.1E-03
Na	1.0E-02	2.0E 02
P	1.0E 05	2.0E 04
Cr	2.0E 02	2.0E 03
Mn	4.0E 02	9.0E 04
Fe	1.0E 02	3.2E 03
Co	5.0E 01	2.0E 02
Ni	1.0E 02	1.0E 02
Cu	5.0E 01	4.0E 02
Zn	2.0E 03	1.0E 04
Br	4.2E 02	3.3E 02
Rb	2.0E 03	1.0E 03
Sr	3.0E 01	1.0E 02
Y	2.5E 01	1.0E 03
Zr	3.3E 00	6.7E 00
Nb	3.0E 04	1.0E 02
Mo	1.0E 01	1.0E 01
Tc	1.5E 01	5.0E 00
Ru	1.0E 01	3.0E 02
Rh	1.0E 01	3.0E 02
Te	4.0E 02	6.1E 03
I	1.5E 01	5.0E 00
Cs	2.0E 03	1.0E 03
Ba	4.0E 00	2.0E 02
La	2.5E 01	1.0E 03
Ce	1.0E 00	1.0E 03
Pr	2.5E 01	1.0E 03
Nd	2.5E 01	1.0E 03
W	1.2E 03	1.0E 01
Np	1.0E 01	4.0E 02

* Table taken from Regulatory Guide 1.109 (Rev.1)

B1.0 MCGUIRE NUCLEAR STATION RADWASTE SYSTEMS

B1.1 LIQUID RADWASTE PROCESSING

The liquid radwaste system at McGuire Nuclear Station (MNS) is used to collect and treat fluid chemical and radiochemical by-products of unit operation. The system produces effluents which can be reused in the plant or discharged in small, dilute quantities to the environment. The means of treatment vary with waste type and desired product in the various systems:

A) Filtration - All waste sources are filtered during processing. In some cases, such as the Floor Drain Tank (FDT) Subsystem of the Liquid Waste (WL) System, filtration may be the only treatment required.

B) Adsorption - Adsorption of halides and organic chemicals by activated charcoal (Carbon Filter) is used primarily in treating waste in the Laundry and Hot Shower Tank (LHST) Subsystem of the WL System. FDT waste may also be treated by this method.

C) Ion Exchange - Ion exchange is used to remove radioactive cations from solution, as in the case of either LHST or FDT waste in the WL System after removal of organics by carbon filtration (adsorption). Ion exchange is also used in removing both cations (cobalt, manganese) and anions (chloride, fluoride) from evaporator distillates in order to purify the distillates for reuse as makeup water. Distillate from the Waste Evaporator in the WL System and the Boron Recycle Evaporator in the Boron Recycle System (NB) can be treated by this method, as well as FDT, LHST waste, and reactor bleed.

D) Gas Stripping - Removal of gaseous radioactive fission products is accomplished in both the WL Evaporator and the NB Evaporator.

E) Distillation - Production of pure water from the waste by boiling it away from the contaminated solution which originally contained it is accomplished by both evaporators. Proper control of the process will yield water which can be reused for makeup. Polishing of this product can be achieved by ion exchange as pointed out above.

F) Concentration - In both the WL and NB Evaporators, dissolved chemicals are concentrated in the lower shell as water is boiled away. In the case of the WL Evaporator, the volume of water containing waste chemicals and radioactive cations is reduced so that the waste may be more easily and cheaply solidified and shipped for burial. In the NB Evaporator, the dilute boron is concentrated to 4% so that it may be reused for makeup to the reactor coolant system.

Figure B1.0-1 is a schematic representation of the liquid radwaste system at McGuire.