

Environmental impact factor (EIF) use in Norway

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Background for EIF

- There was a need for having a tool taking into consideration the “Zero harmful effect discharge” policy implemented by environmental authorities.
- The regulators had a need to have a plan on how the operators intend to achieve the “Zero harmful effects” by 2005 provoked the use of EIF, a part of DREAM
- DREAM (Dose-Related Exposure Assessment Model) is focused on quantifying and predicting the potential long term effect of produced water discharges.
- EIF focus on PEC/PNEC approach and not on the ecological effect.

DREAM

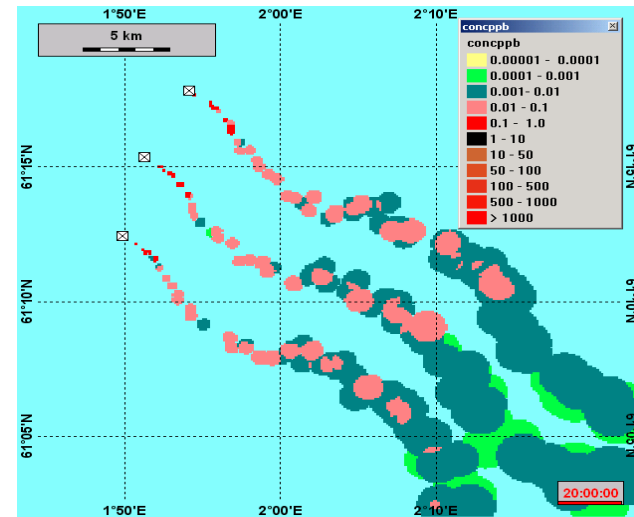
The Dose-related Risk and Effects Assessment Model (DREAM) is a tool for assessing the consequences of regular, planned releases to the marine environment. DREAM helps visualization and analysis of releases occurring over extended time periods and large water volumes. Some of the tasks suitable for DREAM include:

- Analysis of impacts on the environment from releases of produced water
- Time-varying exposure of representative individual organisms
- Habitat grids
- Acute and chronic effects calculations
- Risk assessment
- EIF (environmental impact factor) calculations
- Decision-making and approval of planned releases

EIF in a few words

- EIF is a combined Risk and Hazard assessment of produced water discharges taking into consideration both amount and composition of the oil and the chemicals used (not mud at the present time)
 - PEC: modeling fate of PW (chemicals & oil) with 3D dispersion models
 - Risk assessment: PEC/PNEC approach. Risk can be added from different sources (ie. platforms, sub-sea) and for different components
 - Uses water volumes where PEC/PNEC exceeds 1
 - Additional weighing of certain compounds used based on specific additional informational.
 - Output is one number that is specific for each scenario.

⇒ Conservative approach



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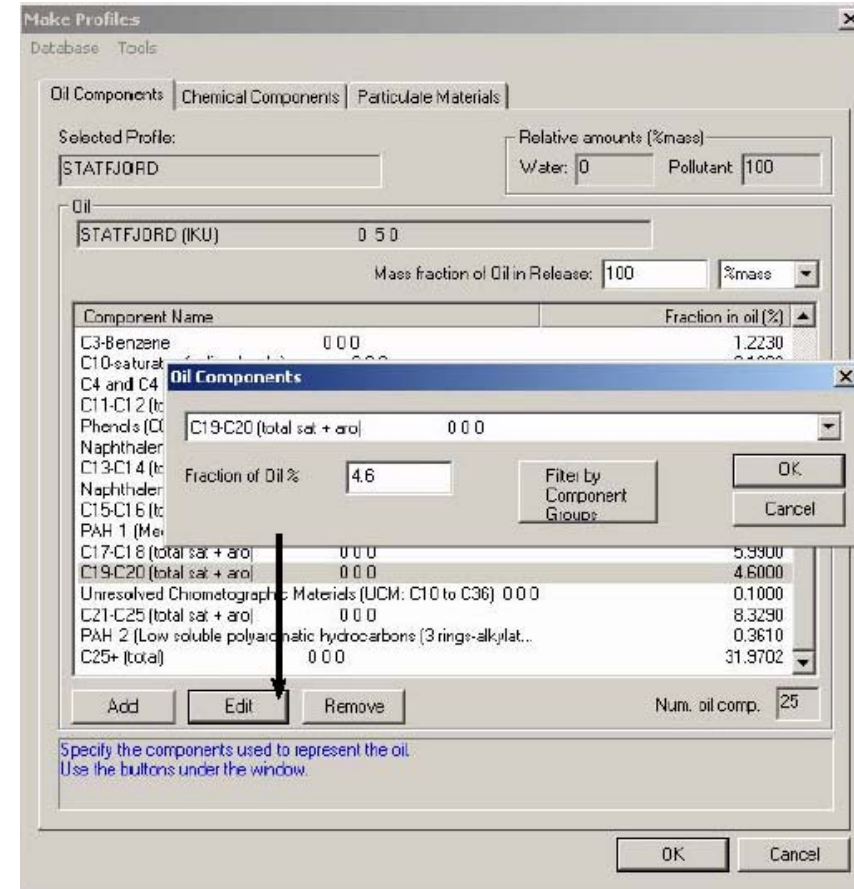
Input data (1)

- Locate the release site (platform, FPSO, sub-sea installation)
- Environmental input data
 - Current grids (background current, tidal current, can be set inn specifically or use a standard for being able to compare different installations)
 - Wind (choose standard)
 - Depths
 - Habitat grids
- Specify scenario parameters (release depth, temperature, salinity, release rate)
- Number of release days



Input data (2)

- Oil composition
 - Can be standard (in order to make comparisons between scenarios) or specific.
- Chemicals used
 - Profile specific for each installation



EIF setup

- Physical fate of particles
 - Number particles, depth, lower concentration...
- Near field fate model
 - 3D plume model: oil droplets size and specifics
- Output settings
 - Concentration limits for information being shown in excel sheet

The screenshot shows the 'Model Parameters' dialog box with the following settings:

- Physical Fates** (selected tab):
 - Number of liquid and solid particles: 500
 - Number of dissolved particles: 1000
 - Number of cells in concentration grid (xyz): 200 x 200 x 5
 - Expanding grid
 - Lower concentration limit (ppb): 2
 - Depth for concentration grid (m): Min: 0, Max: 20
 - Initial, thick limit and terminal surface film thickness (mm): 20, 0.10000, 0.001
 - Output interval: 15 hrs
 - Time step: 15 hrs
 - Random seed: Randomized, User defined (0)
 - Surface drift rate: 3.5 % wind speed
- Bottom text: Specify the number of particles to use for representation of the floating contaminant.
- Buttons: OK, Cancel

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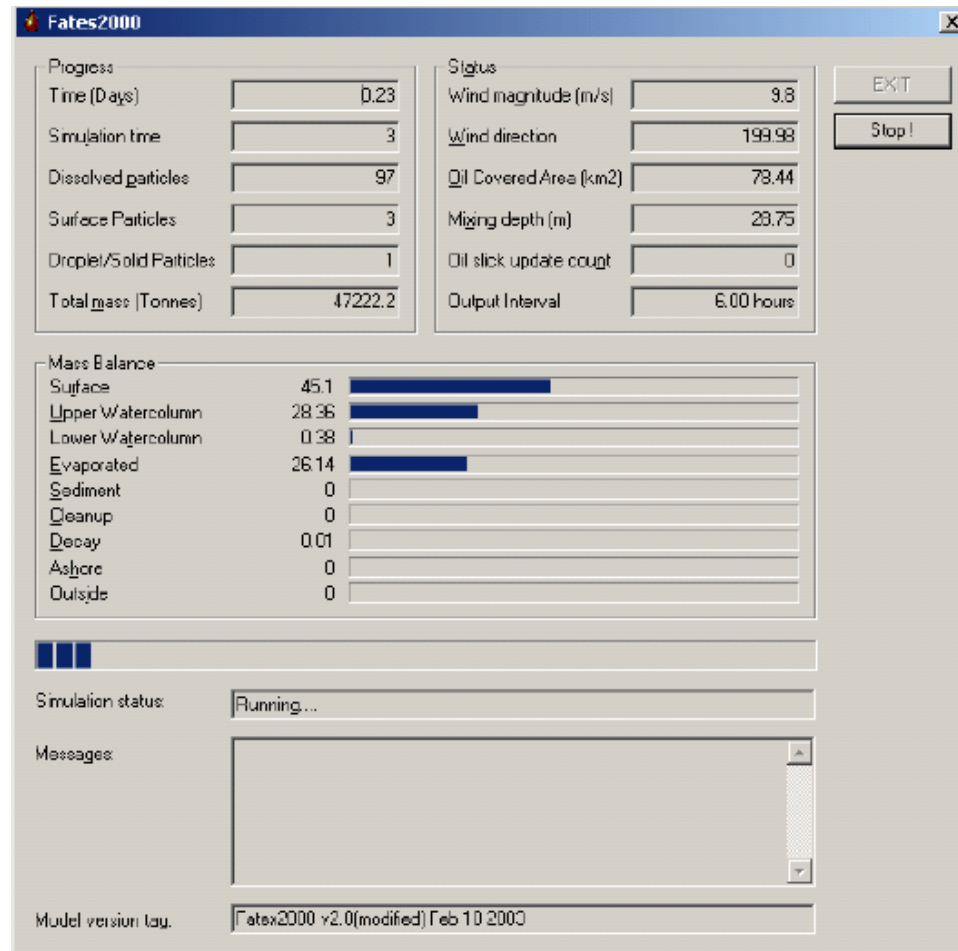
EIF setup

- Current wind
 - Predefined grids (would be region specific)
- Defining the extend of a grid for EIF calculations
- Iterations to define numbers of risk field within the grid higher or lower than 5% risk

The screenshot shows the 'EIF Parameters' dialog box with the following settings:

- EIF environmental parameters:**
 - Use predefined list of currents and winds
 - Use user-defined currents and winds
 - Wind: gulfaks.wnd (Select...)
 - Currents: 90MAY.DIR (Select...)
 - Save generated grid as: (Save As...)
 - Province: North Sea (Select...)
 - BG Conc.: NO BACKGROUND CONC (Select...)
 - Size of habitat grid area(xy): 20 20 km
 - Number of cells in concentration grid(xyz): 100 100 10
 - Calculated model resolution: 200 by 200 m
 - Minimum model resolution(xy): 100 100 m
- Physical model parameters:**
 - Number of liquid and solid particles: 100
 - Number of dissolved particles: 200
 - Lower concentration limit (ppb): 0.001
 - Depth for concentration grid (m): Min 0 Max 100
 - Output interval: 12 hrs
 - Random seed:
 - Randomized
 - User defined 966

Run the model



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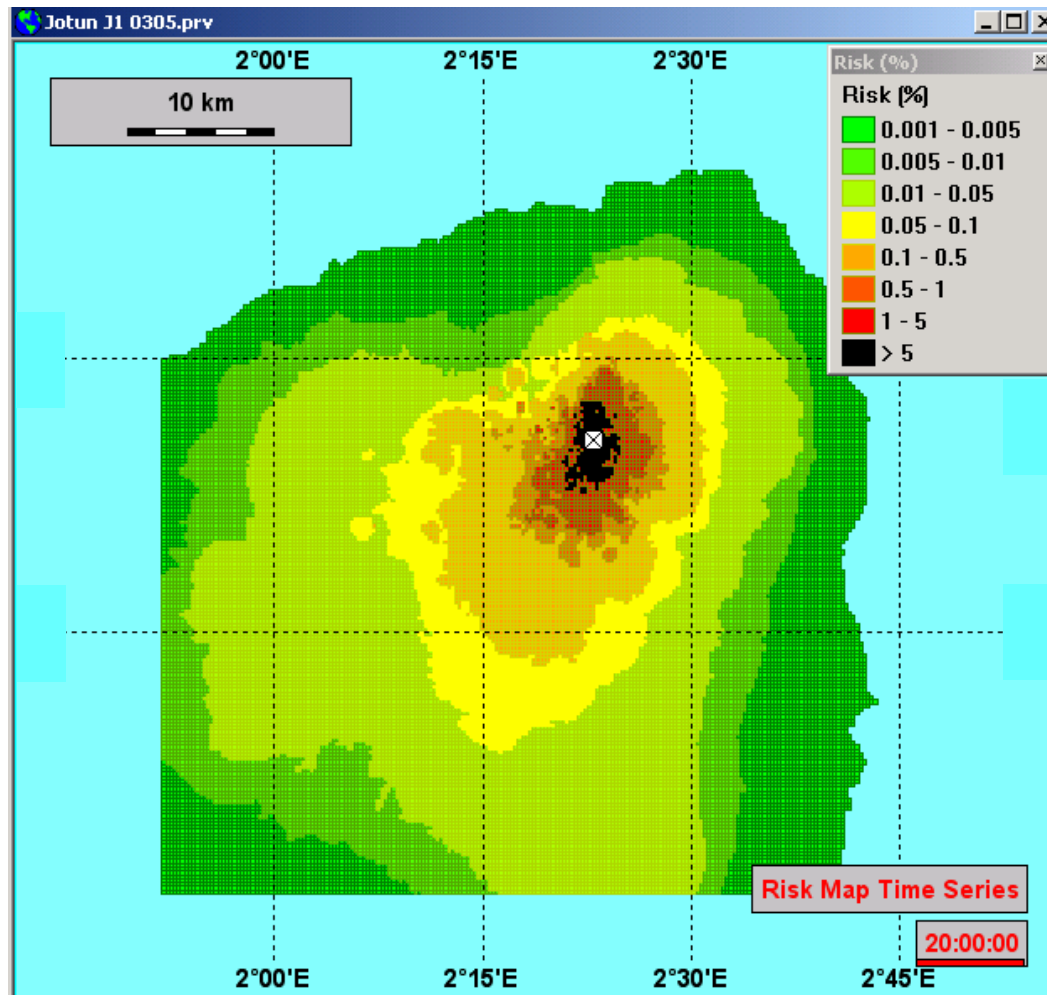


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Example Simulation (1)

Risk map of all PW components



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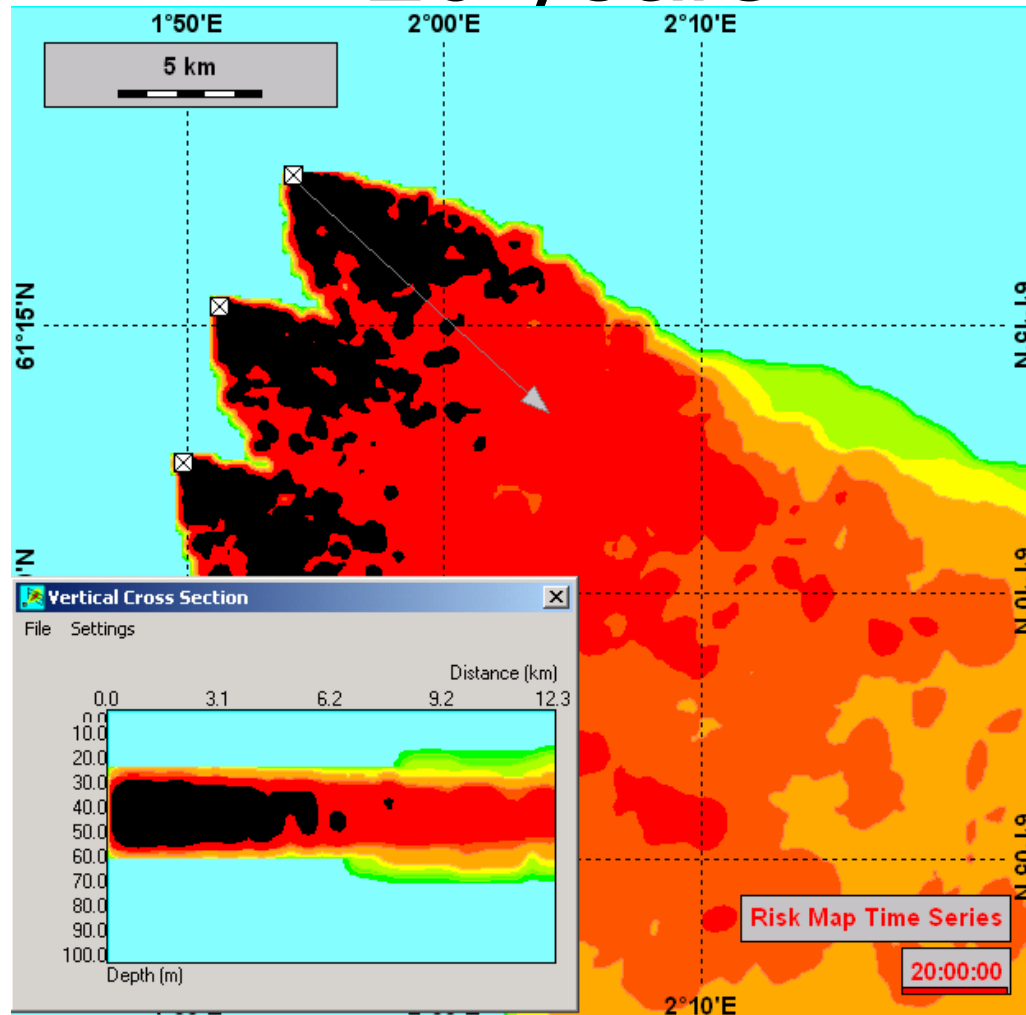


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Example Simulation (2)

20 years



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Examples of scenarios

- No actions
- Today's situation
- Re-injection of PW with two injection pumps
- PW cleaning by technology 1.
- PW cleaning by technology 2
- Dispersed oil reduction with technology 3
- Chemical substitution several possibilities

One EIF running will be done for each scenario

PNEC for chemicals

TradeName	Function	SubstanceN: CAS_No	Mol Weight	Conc Avg	Skeleton	Acrtia t	Scophthal	Corophium	Abra alba	LogPow	Method	BioDeg	Method
Chemical A	Defoamer	Preparation		100	205	2837	1800		280				
		Deodorised kerosene	< 800	83,33	1000	556	1800	1157		5,3999	OECD 117	100	OECD 306
		Silicone fluid	>= 600	16,67			88900	30700		0	Literature	2	BODIS SW
Chemical B	Emulsion breaker	Preparation		100									
		Oxylalkylated amine		7,5	16,7	71				1,9	OECD 117	3	BODIS
		Oxylalkylated amine		22,5	16,7	71				1,9	OECD 117	3	BODIS
		Polyalkylene glykol		7	70	80		1851		2,68	OECD 117	19	BODIS
		Aromatic solvent	<600	55	320					3,5	OECD 117	70	OECD 306
		2-Butoxyethanol	118,2	8	570	730				2,19	OECD 117	71	OECD 306

Example on how PNEC (Predicted No Effect Concentration) values for chemicals are chosen:

- Within a chemical mixture the most toxic substance is chosen (often lowest EC50 value)
- the chosen substance will represent the mixtures PNEC value
- if values for the mixture exist they will be used
- ecotoxicology know-how is needed to evaluate
- conservative approach

Example of EIF data output

Scenario X

MEMW 1.2beta

Standard input

13.5 m dd

Scenario specific input

Simulated EIF

101

Chemical specific input

(dd= discharge depth)

Component group	Dishcharge tonn/day		Conc. ppm		PNEC ppb		Contr. to risk %	Contr. EIF	Weight	Weighed contr.	
	Simulated	New	Basis	New	Basis	New					
Total	24273	24273									
BTEX			6,2	6,2	17	17	3,64	3,6764	1	3,68	
Naphthalenes			0,741	0,741	2,1	2,1	8,5	8,585	1	8,59	
2-3 ring PAH			0,03162	0,03162	0,15	0,15	16,77	16,9377	1	16,94	
4-ring+ PAH			0,00038	0,00038	0,05	0,05	0,45	0,4545	2	0,91	
Phenol C0-C3			2,3583	2,3583	10	10	4,54	4,5854	1	4,59	
Phenol C4-C5			0,01	0,01	0,36	0,36	1,36	1,3736	1	1,37	
Phenol C6-C9			0,0026	0,0026	0,04	0,04	5,03	5,0803	2	10,16	
Alifates			16	16	40,4	40,4	33,7	34,037	2	68,07	
Cu			0,000526	0,00053	0,02	0,02	1,64	1,6564	1	1,66	
Hg			0,000035	3,5E-05	0,008	0,008	0,27	0,2727	1	0,27	
EC-6165A			0,428	0,428	426	426	0,05	0,0505	1	0,05	
KI-384			0,068	0,068	63	63	0,04	0,0404	1	0,04	
FX-2099			0,0023	0,0023	18,3	18,3	0	0	1	0,00	
PI-795			0,00113	0,00113	37	37	0	0	2	0,00	
EC-9242ASiFI			0,000765	0,00077	30700	30700	0	0	2	0,00	
EC-6191A			0,374426	0,37443	10	10	2,92	2,9492	1	2,95	
Grid size: 100x100km									Adjusted EIF		119

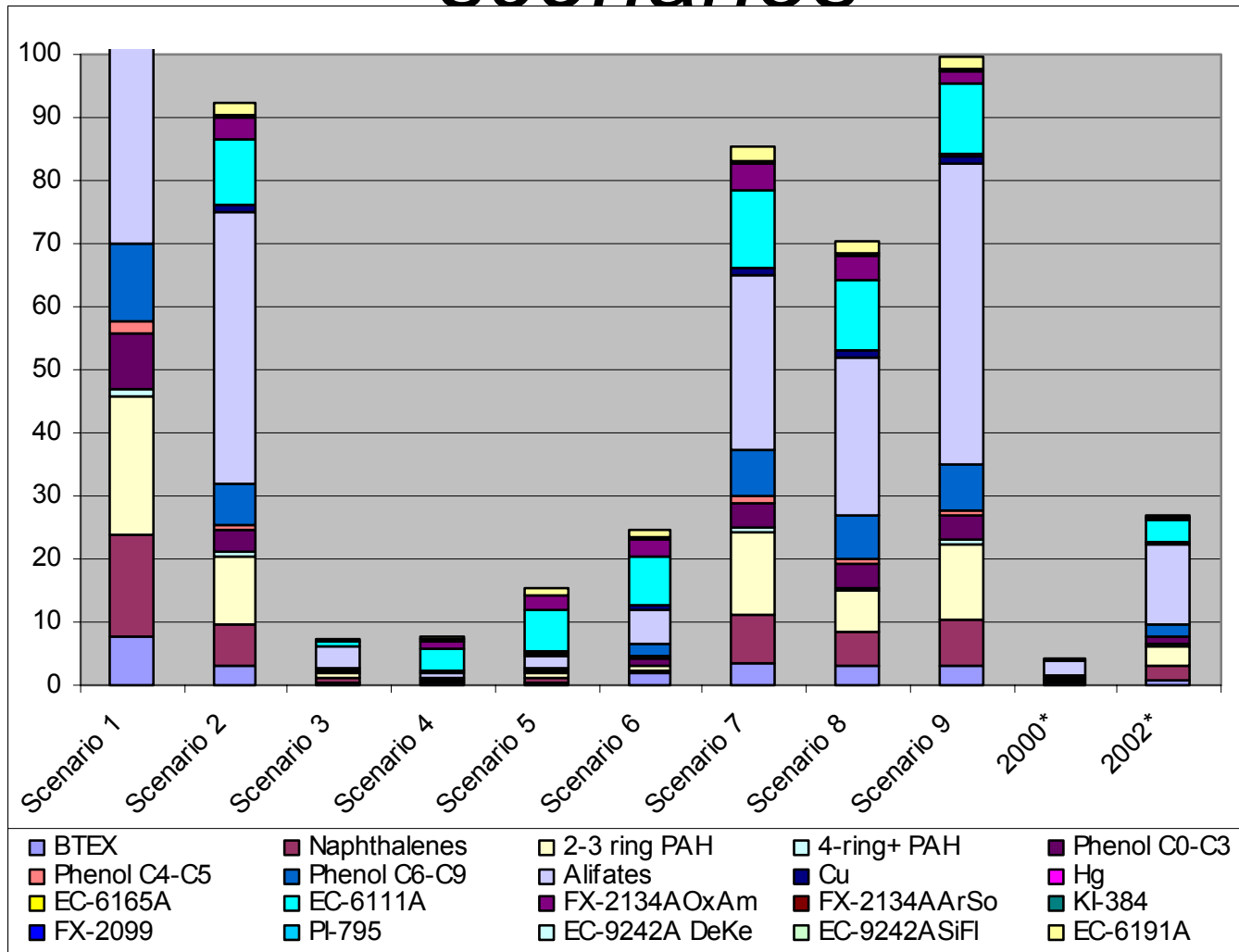
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Contribution to risk for different scenarios



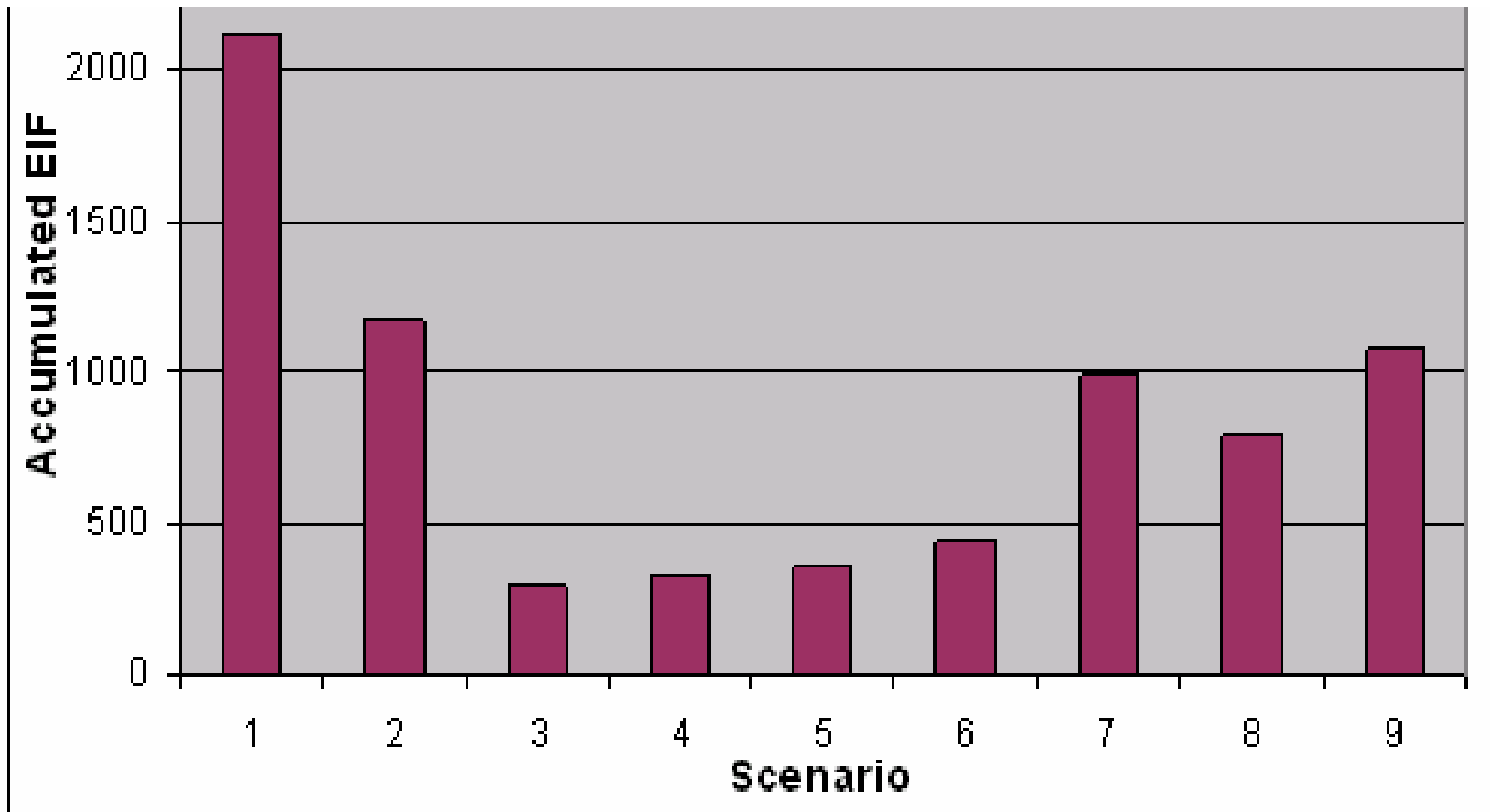
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Example on accumulated risk for the different scenarios



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Conclusions

- EIF is used as a risk indicator
- EIF number makes it possible to compare different scenarios (technology, management) for the same installation
- At the present time there are no acceptance criteria connected to the risk number
- Each EIF is specific for each installation
- Models can be run for a single installation or several platforms at the same time -> regional risk assessment
- Possible to make a EIF/\$ used per technology solution

⇒ All offshore operational discharges in Norway have been modeled with EIF simulations