Part 506 – Exhibits

Subpart D – Rehabilitation Project Ranking

506.40 Evaluation of Potential Rehabilitation Projects

EVALUATION OF POTENTIAL REHABILITATION PROJECTS									
STATE		DAM			BY		DATE		
YEAR BUILT			DESIGN HAZARD CLASS			DRAINAGE AREA			mi2
WORK PLAN DATE			CURRENT HAZARD CLASS			DAM HEIGHT			ft
sht 1 of 5	CONSEQUENCES OF DAM FAILURE							ver 100101	

POTENTIAL DAM FAILURE:			
Total Failure Index			A
POTENTIAL LOSS OF LIFE:			
Maximum Population-at-Risk [PAR]		(number)	B
Total Risk Index			C
POTENTIAL LOSS OF PROPERTY:			
Identify major community affected by breach and rate impact as High (H), Medium (M), Low (L) or None(blank)			
Community _____		(H,M,L,-)	D
Number of homes, businesses, major buildings		(number)	E
POTENTIAL LIFELINE DISRUPTION:			
Water supply, identify community disrupted by dam failure, and estimate number/amount			
Municipal sole source _____	Users	(number)	F
Supplemental source _____	Users	(number)	G
Irrigation water _____	Storage	(Ac-Ft)	H
POTENTIAL INFRASTRUCTURE DISRUPTION:			
Transportation system crossings, identify major crossing rendered unusable by dam failure, and estimate number			
Major/Interstate _____	Roads	(number)	I
Secondary/County _____	Roads	(number)	J
POTENTIAL ADVERSE IMPACTS ON THE ENVIRONMENT:			
Describe impacts and rate each as High (H), Medium (M), Low (L), or None (blank)			
Threatened & endangered species _____		(H,M,L,-)	K
Sensitive riparian areas _____		(H,M,L,-)	L
Contaminated reservoir sediment _____		(H,M,L,-)	M
Wetland and wildlife habitat _____		(H,M,L,-)	N
Other _____		(H,M,L,-)	O
POTENTIAL ADVERSE SOCIAL IMPACTS:			
Describe impacts and rate each as High (H), Medium (M), Low (L) or None(blank)			
Known cultural resources _____		(H,M,L,-)	P
Historic preservation issues _____		(H,M,L,-)	Q
Socially disadvantaged community _____		(H,M,L,-)	R
POTENTIAL ADVERSE ECONOMIC IMPACTS:			
Average annual benefits attributed to this dam, updated workplan value		($)	S
Changes in benefits since workplan; Increase(I), No change(NC), Decrease(D)		(I,NC,D)	T
Low income families impacted		(number)	U
INPUT BY STATE DAM SAFETY AGENCY:			
State dam safety order issued for repair, modification, removal issued, Yes(Y), No(N)		(Y,N)	V
State Dam Safety Agency Priority, High(H), Medium(M), Low(L), None(blank)		(H,M,L,-)	W
OTHER CONSIDERATIONS:			
Identify any other considerations and rate as High(H), Medium(M), Low(L) or None(blank)			
_____		(H,M,L,-)	X
		(H,M,L,-)	Y

EVALUATION OF POTENTIAL REHABILITATION PROJECTS

STATE		DAM		BY		DATE	
sht 2 of 5		**FAILURE & RISK INDEXES**					ver 102201

Adopted from Bureau of Reclamation "Risk Based Profile System"
see: http://www.usbr.gov/dsis/risk/rbpsdocumentation.pdf

LIFE LOSS:

Population-at-Risk [PAR], see NRCS dams inventory definition (number of people)

Estimate PAR for static loading failure, typically assume water at top of dam		A
Estimate PAR for hydrologic loading failure, typically assume water at top of dam		B
Estimate PAR for seismic loading failure, typically assume water at ES crest (sunny day failure)		C

Fatality Rates [FR] from dam breach
Adopted from BuRec "A Procedure for Estimating Loss of Life Caused by Dam Failure" DSO-99-06
see: http://www.usbr.gov/research/dam_safety/documents/dso-99-06.pdf
Flood Severity/Lethality [DV] is the average depth [D] times velocity [V] across flood plain (ft2/sec)
DV= (breach discharge - bank full discharge) / breach floodplain width
Warning Time [T] between failure warning and flood wave at population (minutes)
Flood Severity Understanding [U] of the warning issuer of the likely flooding magnitude

scenario	breach discharge (cfs)	bankfull discharge (cfs)	breach width (ft)	DV (ft2/sec)	warning time (minutes)	under-standing (N/A or Vague)
Static						
Hydrologic						
Seismic						

For	DV>50	T=0	U=N/A (no warning)	FR=0.15
For	DV>50	T<60	U=vague	FR=0.04
For	DV>50	T>60	U=vague	FR=0.03
For	DV<50	T=0	U=N/A (no warning)	FR=0.01
For	DV<50	T<60	U=vague	FR=0.007
For	DV<50	T>60	U=vague	FR=0.0003

Estimate FR for static loading failure scenario		D
Estimate FR for hydrologic loading failure scenario		E
Estimate FR for seismic loading failure scenario		F

Scenario	Load Factor	Response Factor	Failure Index	Fatality Rate	PAR	Risk Index
Static	1					
Hydrologic	*	*				
Seismic						
		TOTAL=			TOTAL=	

EVALUATION OF POTENTIAL REHABILITATION PROJECTS									
STATE		**DAM**		**BY**		**DATE**			
sht 3 of 5	**STATIC FAILURE INDEX**							ver 100101	
PRINCIPAL SPILLWAY SYSTEM (60 points max):					(total points)				A
Downstream filter or filter zone around conduit (yes=0 or no=10)									B
Conduit trench deep (>2d) and narrow (<3d) and steep sideslope (<2:1) (no=0 or yes=10)									C
Principal spillway system (inlet, pipe, or outlet) in deteriorated condition (no=0 or yes=10)									D
Conduit has seepage cutoff collars or other compaction adverse features (no=0 or yes=10)									E
Conduit contains open joints, open cracks, steady seepage (no=0 or yes=10)									F
Conduit founded on competent bedrock (yes=0 or no=10)									G
Reservoir control gate located at outlet of conduit (no=0 or yes=10)									H
RESERVOIR FILLING HISTORY (75 points max):					(total points)				I
Reservoir has filled to x% of effective height (earth spillway crest minus original streambed)									J
(<50%=75 or 51-75%=50 or 76-90%=25 or 91-95%=10 or 96-100%=5 or >100%=0)									K
SEEPAGE AND DEFORMATION (85 points max):					(total points)				L
Seepage carrying fines, or seepage increases with reservoir elevation increases, or sinkholes/jugholes exist in embankment (no=0 or yes=80)									M
Large amounts of seepage (no=0 or yes=6)									N
Visible and significant slope movement or sloughing (no=0 or yes=6)									O
Longitudinal or transverse embankment cracking greater than one foot in depth (no=0 or yes=6)									P
Sinkholes/depressions within two times effective height of the dam, either face (no=0 or yes=6)									Q
Poor top of dam condition, eroded, trees, rodent holes, settlement (no=0 or yes=6)									R
Abnormally wet areas at downstream toe/groin of embankment (no=0 or yes=6)									S
Inadequate slope protection against erosion by rainfall or waves (no=0 or yes=6)									T
FOUNDATION GEOLOGY (41 points max):					(total points)				U
Highly fractures rock under core (no=0 or treated=3 or untreated=30)									V
Karst terrain and soluble rock (gypsum or limestone) (no=0 or treated=3 or untreated=30)									W
Collapsible soils (no=0 or treated=3 or untreated=30)									X
Significant stress relief fractures in abutments (no=0 or treated=3 or untreated=30)									Y
History of underground mining under embankment area (no=0 or treated=3 or untreated=30)									Z
Coarse grained and highly permeable soils (no=0 or yes=3)									AA
Presence of weak layers/conditions diminishing embankment stability (no=0 or yes=3)									AB
Erodible soils (sandy/silty materials) or weakly cemented rock (no=0 or yes=3)									AC
Reservoir area prone to landslides that could cause overtopping (no=0 or yes=3)									AD
EMBANKMENT DESIGN AND CONSTRUCTION (24 points max):					(total points)				AE
Filters for core or foundation or incompatibility between zones (no=3 or yes=0)									AF
Embankment or foundation drainage system (yes=0 or no=4)									AG
Erodible core material (sands, silts, dispersive clays) (no=0 or yes=4)									AH
Incomplete or no foundation cutoff of shallow permeable layers (no=0 or yes=4)									AI
Poorly placed earthfill, inadequate density (no=0 or yes=4)									AJ
Gate features to drain reservoir (yes=0 or no=4)									AK
EMBANKMENT MONITORING (15 points max):					(total points)				AL
Instruments (except surficial survey points) installed at dam (yes=0 or no=3)									AM
Installed instruments routinely read and evaluated (yes=0 or no=3)									AN
Visual inspection of dam by engineer less often than yearly (no=0 or yes=3)									AO
Good physical/visual access to downstream groin/toe for inspection (yes=0 or no=3)									AP
STATIC FAILURE INDEX: A+I+L+U+AE+AL									AQ

EVALUATION OF POTENTIAL REHABILITATION PROJECTS								
STATE		**DAM**		**BY**		**DATE**		
sht 4 of 5	**HYDROLOGIC FAILURE INDEX**							ver 100101
HYDROLOGIC LOADING:								
Total Spillway Capacity (PS&ES) for 6hr storm [Pfb], Work Plan Tbl 3 (rainfall inches)								A
Obtained from Work Plan Tbl 3, or dams inventory data, or computer routings								
100 year, 6hr rainfall [P100] (inches)								B
Probable Maximum Precipitation [PMP] (inches)								C
if Pfb < P100	=		enter	40				
if Pfb = P100+0.2(PMP-P100)	=		enter	25				
if Pfb = P100+0.4(PMP-P100)	=		enter	15				
if Pfb = P100+0.6(PMP-P100)	=		enter	7				
if Pfb = P100+0.8(PMP-P100)	=		enter	3				
if Pfb = PMP	=		enter	1				
Enter interpolated value								D
HYDROLOGIC UNCERTAINTY:								
Drainage Area [DA] (square miles)								E
DA<10 enter 1.5 ; 10<DA<20 enter 1.4 ; 20<DA<50 enter 1.3 ; DA=>50 enter 1.2								F
PIPE SPILLWAY PLUGGING:								
Pipe Diameter [D] (inches)								G
D<12 enter 1.1; 12<=D<24 enter 1.0; 24<=D enter 0.9								H
Riser & trash rack type:								
Non-standardized inlet enter 1.1, Open Top riser enter 1.0; Covered or Baffle Top enter 0.9								I
EARTH SPILLWAY FLOW:								
Earth spillway flow depth [Des] from top of dam to spillway crest (feet)(10' max)								J
DAM EROSION RESISTANCE:								
Non-plastic (PI<10) fill enter 2.0 ; Plastic core enter 1.7 ; Overtopping armoring enter 0.8								K
Vegetal Cover Factor [Cf], see SITES or AH667								L
http://www.pswcrl.ars.usda.gov/ah667/ah667.htm								
Cf <0.4 enter 1.1; Cf < 0.7 enter 1.0; Cf<1.0 enter 0.9; larger Cf enter 0.8								M
EARTH SPILLWAY EROSION RESISTANCE:								
Low, can be excavated with hand tools, enter 2.0								
PI>10 and SPT blows<8, PI<10 and SPT blows>8, Kh<0.10, seismic velocity<2000fps								
Moderate, can be excavated with construction equipment, easy ripping, enter 1.2								
PI>10 and SPT blows>8, PI<10 and SPT blows>30, Kh<10, seismic velocity<7000fps								
High, very hard ripping, requires drilling and blasting, enter 0.2								
moderately hard rock, Kh>10, seismic velocity>7000fps								N
Vegetal Cover Factor [Cf], see SITES or AH667								O
Cf <0.4 enter 1.1; Cf < 0.7 enter 1.0; Cf<1.0 enter 0.9; larger Cf enter 0.8								P
HYDROLOGIC FAILURE INDEX:								
dam overtopping breach: (2)(D)(F)(H)(I)(K)(M)								Q
earth spillway breach: (D+5J)(F)(H)(I)(N)(P)								R
larger of (2)(D)(F)(H)(I)(K)(M) or (D+5J)(F)(H)(I)(N)(P) but less than 300								S

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE		**DAM**		**BY**		**DATE**	
sht 5 of 5	**SEISMIC FAILURE INDEX**						ver 102201

SEISMIC LOADING:		
Latitude (degrees.decimal)		A
Longitude (degrees.decimal)		B
See "http://eqint.cr.usgs.gov/eq/html/lookup.shtml"		
PGA [peak ground acceleration] for 2% chance in 50 years, see NEHRP maps (%g)		C
if PGA is less than 10% g, enter 0		
if PGA is between 10% g and 19% g, enter 0.15		
if PGA is between 20% g and 39% g, enter 0.30		
if PGA is between 40% g and 59% g, enter 0.65		
if PGA is greater than 60% g, enter 1.0		D
FOUNDATION LIQUEFACTION:		
Select only one of the following foundation conditions which best represents the site		
Loose alluvium, lacustrine, loess materials (no=0 or yes=10)		E
Bedrock, glacial till, highly clayey materials (no=0 or yes=5)		F
EMBANKMENT FREEBOARD FOR FOUNDATION LIQUEFACTION:		
Dam height for seismic event is the height from top of dam to downstream channel bottom (ft)		G
Freeboard for seismic event is the depth from top of dam to assumed pool surface (ft)		H
Freeboard percent of dam height (%)		I
if Freeboard is less than 25% of dam height, enter 10		
if Freeboard is 25% to 50% of dam height, enter 5		
if Freeboard is more than 50% of dam height, enter 1		J
EMBANKMENT FREEBOARD FOR EMBANKMENT CRACKING:		
Freeboard is less than or equal to 15 feet (no=0 or yes=1)		K
EMBANKMENT CRACKING:		
Embankment contains self-healing filter zones (no=4 or yes=0)		L

SEISMIC FAILURE INDEX:		
(D) ((E)(J) + (F)(K+1)(L+1)) but less than 100		M

State Conservation Engineer's Signature
concurring with technical content of sheets 2 thru 5