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