Frequently Asked Questions(FAQs) for carrying out Rapid Risk Assessment of specified Dams

The exercise of Rapid Risk Assessment (RRA) requires knowledge about wide spectrum of dam engineering. Although, it's always advisable to fill the RRA sheet based upon the documented information, but the same may not be readily available. In such cases, it has been observed by NDSA that the officers face difficulty in carrying out the RRA. The current document aims at resolving this issue. Moreover, there are some information in comment section, which needs to be mandatorily filled to ease the task of the reviewers. The current document specifies that also.

TC-2 Inflow Design Flood:

Highest recorded flood should be taken from the available inflow flood records. The same should be recorded in the remarks.

TC- 2 Seismic Design & EC-1 Seismic Resistance:

Q. What does the robust defensive measures for seismic safety means?

i) Defensive measures for embankment dams:

- Earth dams fail during an earthquake due to lateral spreading and settlement that can result in overtopping. Defensive measures include a high factor of safety against seismic loadings, flat slopes and excess freeboard.

ii) Defensive measures for concrete dams:

- Concrete dams can experience deformations and the potential for sliding. Defensive measures include good flexible water stops, good foundation preparation, high factor of safety, good drainage.

Note:-If no information is available about above mentioned defensive measures, then a judgement may be made depending upon the seismic zone in which the dam is located, i.e. dams in seismic zone IV & V dams may be given high risk score to be on conservative side and for dams in seismic zone II may be given low risk score.

- The year 1971 may be taken as a reference w.r.t. to the year of construction to judge whether major deviations from current seismic standards are there.

- Mention the design seismic parameters in the comment section. The approximate "α_h" value to be considered for the evaluation of horizontal seismic acceleration (as per the 35th meeting of NCSDP and 2024 Guidelines of NCSDSP) should be as per the table given below. While choosing the option for the second question of TC-3 and third question of EC-1, compare your "α_h" value with the "α_h" value given in the table and score accordingly.

Seismic Zone II	Seismic Zone III	Seismic Zone IV	Seismic Zone V
0.08 g	0.12 g	0.18 g	0.27 g

- Some of the past major Earthquakes of India are tabulated below. They may be used as a reference to answer the question related to the performance of the dam during past seismic events.

i) Himalayan Frontal Arc:

Place	***Year***	***Magnitude***
Kangra Valley	April 4, 1905	8.6
Bihar-Nepal border	January 1, 1934	8.4
Quetta	May 30, 1935	7.6
North Bihar	1988	6.5
Uttarkashi	October 20, 1991	6.6
Chamoli	March 29, 1999	6.8
Hindukush	November 11, 1999	6.2
Sikkim	September 18, 2011	6.9

ii) Peninsular India:

Place	***Year***	***Magnitude***
Jabalpur	June 2, 1927	6.5
Indore	March 14, 1938	6.3
Bhadrachalam	April 14, 1969	6.0
Koyna	December 10, 1967	6.7
Killari (Latur)	September 30, 1993	6.3
Jabalpur	May 22, 1997	6.0
Bhuj	January 26, 2001	7.6

iii) North-eastern region of India:

Srimangal	July 8, 1918	7.6
S-W Assam	September 9, 1923	7.1
Dhubri	July 2, 1930	7.1
Assam	January 27, 1931	7.6
N-E Assam	October 23, 1943	7.2
Upper Assam	July 29, 1949	7.6
Indo-Myanmar border	August 6, 1988	7.5
Upper Assam	August 15, 1950	8.7

TC-4 Landslides, GLOF's, LDOF's, Debris Flow and Sedimentation:

Q. What if there is no information on sedimentation?

- Review the topographical and other information. If, for example, the dam is in an area of low relief with flat reservoir slopes and no real potential for landslides. The evidence indicates that the dam has a low potential for development of LDOF or getting affected by any landslide. Further, for reservoir sedimentation consider the erosion potential of the catchment and presence of large reservoir in the upstream on the same river. Select somewhere between the best and the worst score. Also, if the dam age is quite old, some sort of sedimentation may be assumed to have occurred.

TC-6 Conduits:

i) Conduits designed after 1985 are better than those designed before because in 1985, proper design standards for conduits were established.
ii) Conduits placed on rock foundation instead of the dam body superior in providing resistance against interface seepage.
iii) Rectangular/Square conduits are better than Circular conduits because material around the periphery of circular conduits is not compacted properly and becomes a potential zone of weakness.
iv) Conduits with filter diaphragm, cradles are always better than those without them because conduit periphery is a candidate of seepage path.
v) Good conduits are made of materials with long-term survivability and have favorable backfill conditions.

TC-7 Filters:

Supporting Document: Longitudinal and cross-section of the dam (It must be mandatorily pasted in the comment section).

All of the base soils need to be protected by means of:

- Chimney and horizontal filters (d/s),
- filter along the core in the upstream side in rockfill dams (for rapid drawdown condition), filter along the core in the downstream side in rockfill dams (for steady state seepage) horizontal filter in different layers,
- foundation filters,
- filters in the downstream portion of the core trench and
- filter at the places where there is stark change of permeability.

Note: -

i) In normal circumstances, height of the filters in u/s & d/s of core should extend up to the FRL & in regions prone to earthquake, it should extend up to the top of impervious core.

ii) Core thickness at a given height should be 50% of the head at that location; thick core is good.

iii) For sands, a factor of safety of 1 in 6 or 7 is good.

iv) As a thumb rule, for filtered exit, hydraulic gradient should not be more than 0.5 and for unfiltered exit, hydraulic gradient should not be more than 0.1.
Gradient is calculated as "H (Head)/ L (Length of seepage path)"

v) All the criteria mentioned in the IS 9429:1999 regarding thickness, slope and particle size of the filter must be satisfied.

Score your dam between 0 to 24 based upon the number of above-mentioned criteria being met. Please mention how the interpolation between 0 and 24 was carried out in the comment section.

- If the drawing is not available, then the scoring may be done based upon the manifestation of the dam behaviour. The presence of continuous seepage / large wet area in the downstream are indications of dam with improper drainage system. The change in patterns of these problems w.r.t. varying reservoir levels shall invite a high risk score.

Q. How do you score a dam that has a very wide core and no upstream and downstream filters along the core (protecting the core) but does have a foundation filter?

Answer: These dams may be somewhat equivalent to a homogeneous dam with a toe drain but do present a higher potential for piping. Evaluate all the available evidence

- Were there any issues on first impoundment?
- How old it the dam?
- Any history of seepage problems, sinkholes, boils etc.?
- Are there high gradients at unfiltered exits?

- Depending on what the evidence tells you the dam should be scored somewhere between a homogeneous dam and the maximum.

TC-8 Foundation:

- If detailed geology report is not available, try to answers from the standard properties rock type.

- If downstream toe drain is receiving high discharge and general ground water level of downstream area increases when reservoir is full, consider it as high permeability.
- For concrete and masonary dam, no reported movement of the blocks under reservoir full condition (i.e. Case – b loading) is a possible candidate of 3rd option in row numbers 6 to 9.
- In case of lack of availability of shear strength, the sum of the upstream and downstream slopes may be used to adjudge the correct option for the question on shear strength. The following table may be useful in this regard:

Sum of upstream and downstream slopes	>1.0	0.95-1.0	0.95-0.85	0.85-0.80	<0.80
Option no. to be selected for the question on shear strength	1	2	3	4	5

- In the comment section, mandatorily mention the facts/ evidences which prompted you to choose a particular option.

EC-1 Available Discharge Capacity:

In this section, the comparison of the discharges should be done w.r.t. two similar quantities. Evidences like increase in Tail Water Level (T.W.L.), decrease in the downstream channel carrying capacity are the indicators of decrease in the discharge capacity. In the comment section, refer the document from which the result has been derived.

Note:-

TC-7 Filter and TC-8 Foundation must be filled carefully and judiciously as they contain highest weightage among all the sheets of TC. In TC-5 length, add all the components of the dam and include dykes and saddle dam, if any.

Caution:

This FAQ is only to assist the RRA exercise. Information given here should not be used for any other purposes.