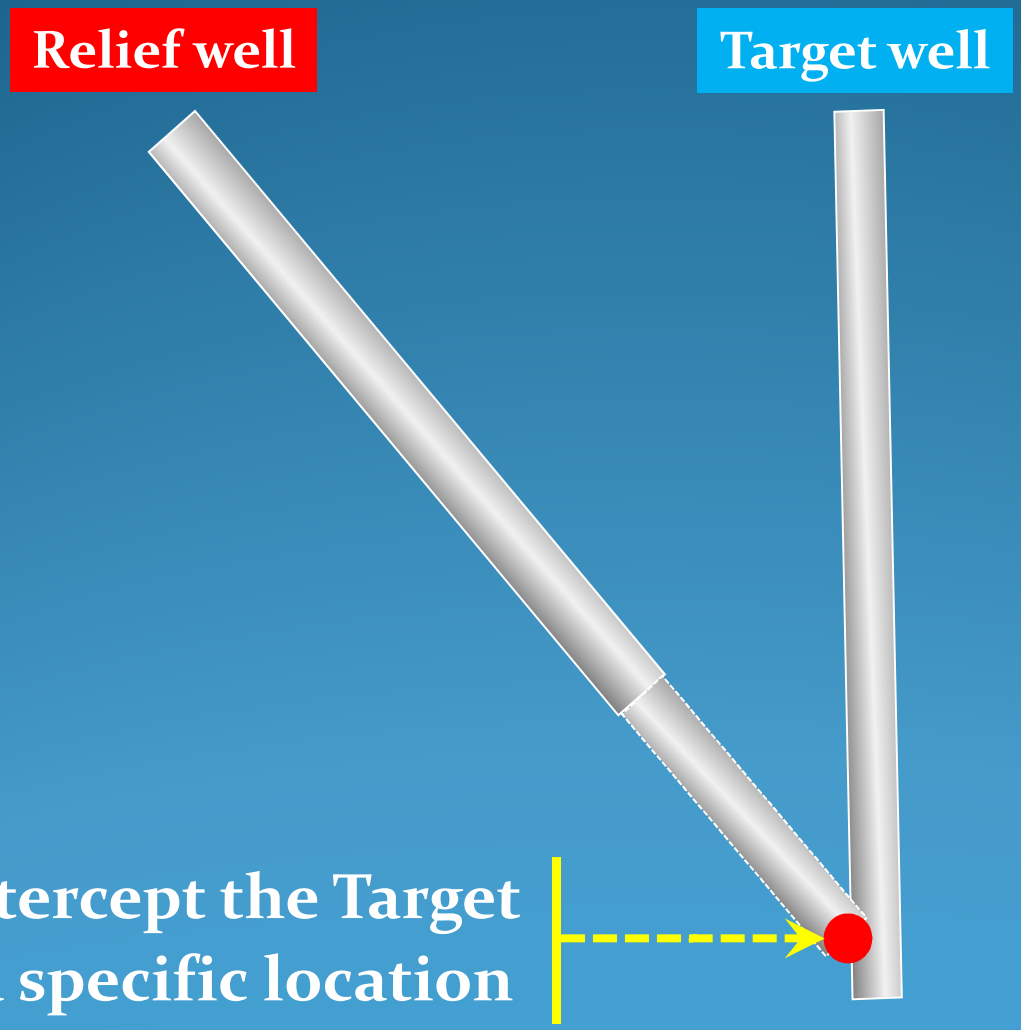
ISCWSA 37th Main Meeting
March 8th 2013

Collision Avoidance & Magnetic Ranging

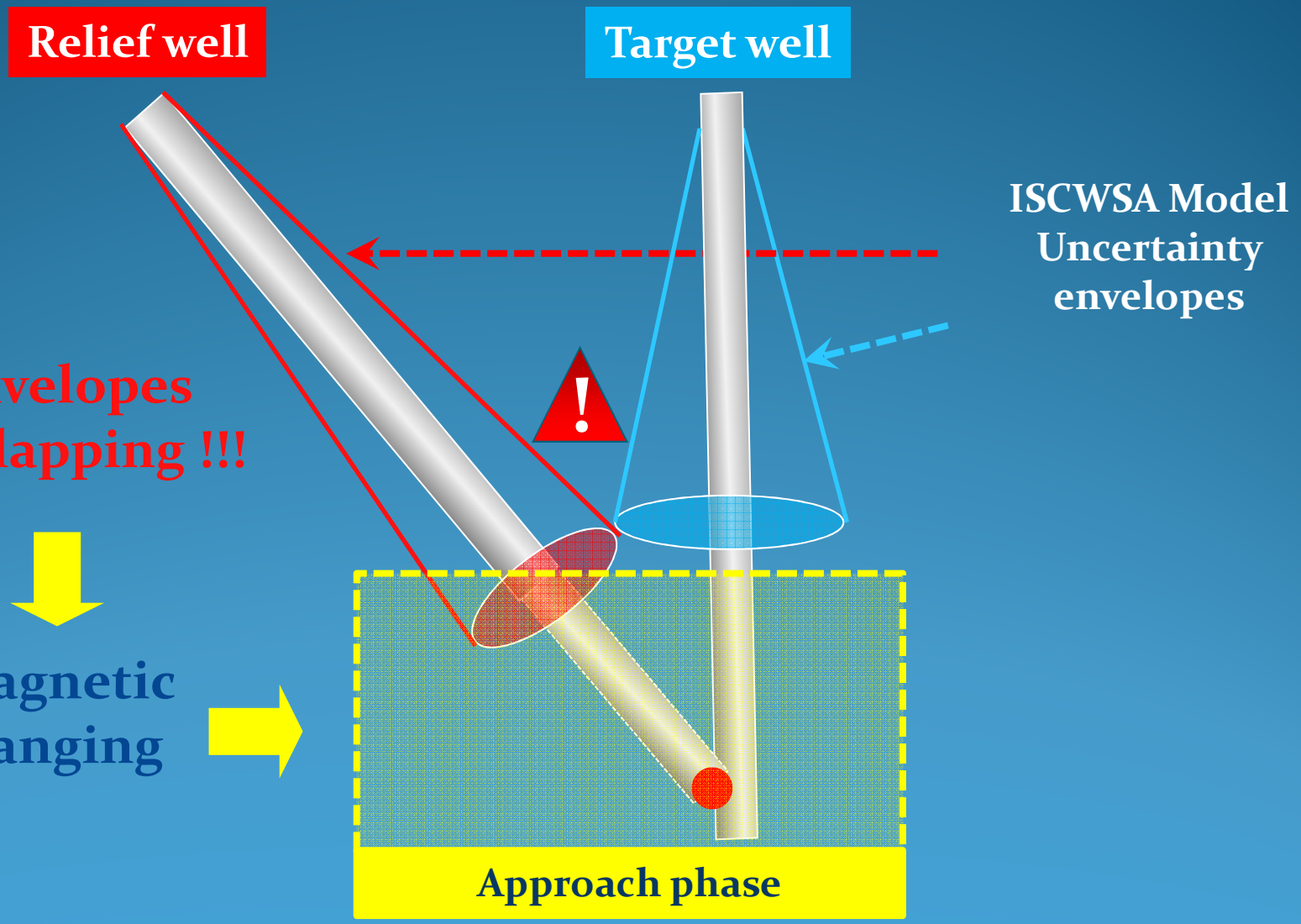
PathControl

Positioning of the Problem



Aim: Intercept the Target well at a specific location

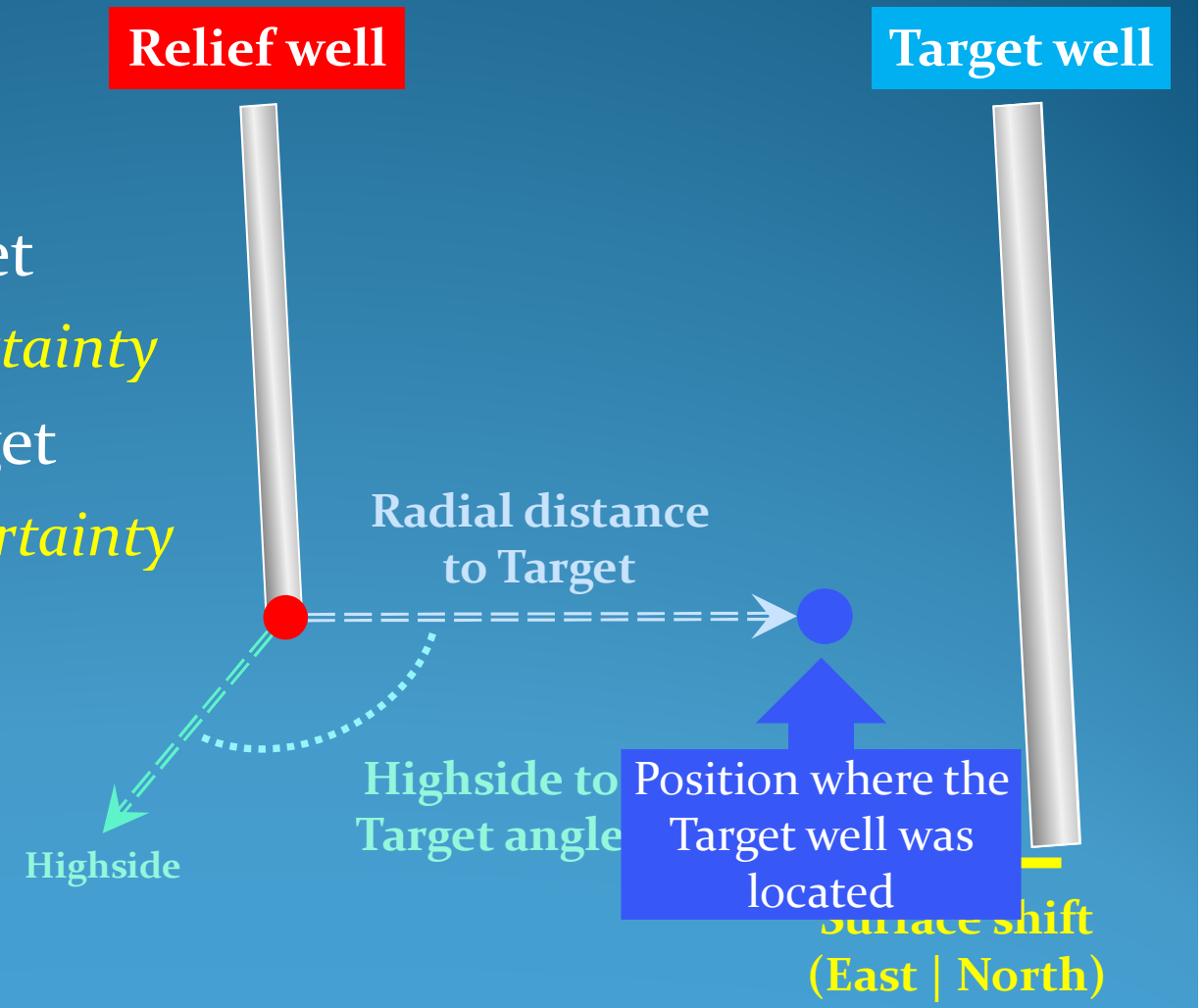
Positioning of the Problem



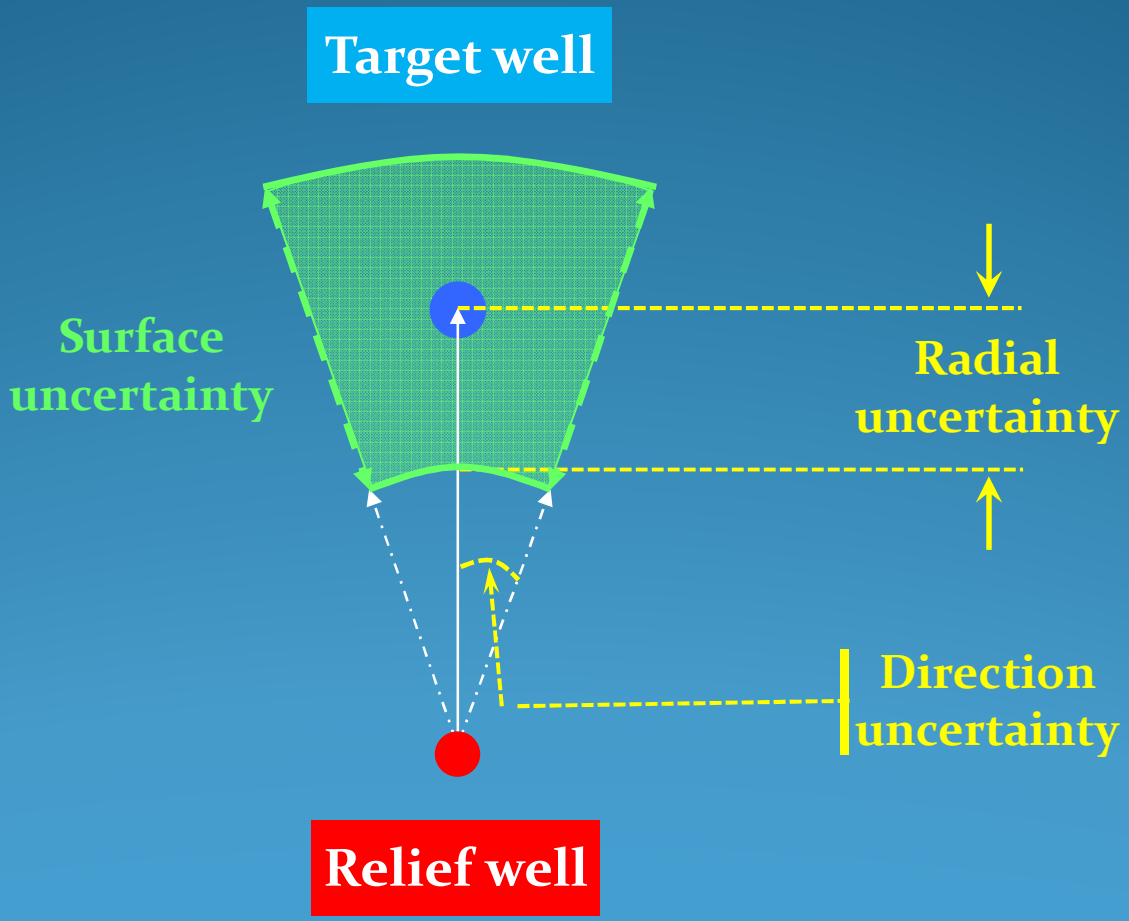
Active Magnetic Ranging

Ranging outputs

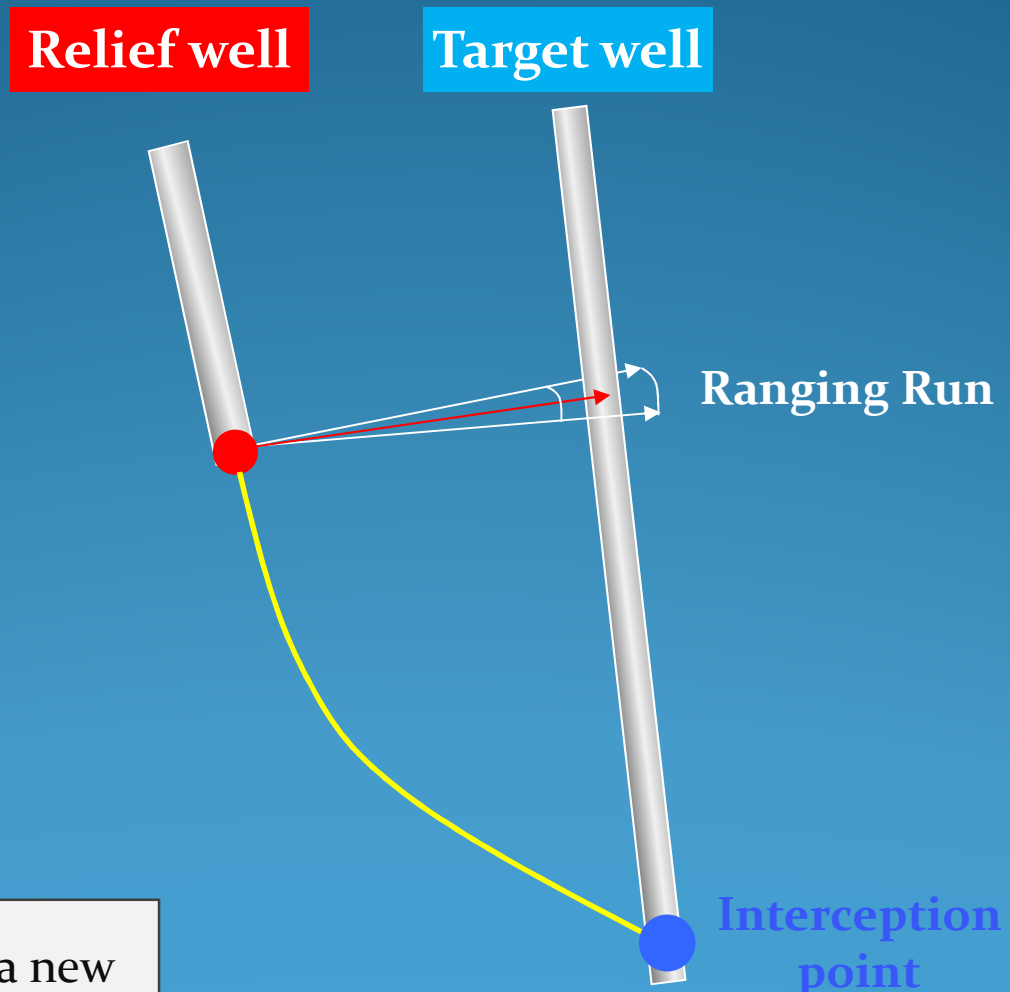
- 2D surface shift
- Distance to Target
  - *Distance uncertainty*
- Direction to Target
  - *Direction uncertainty*



Active Magnetic Ranging

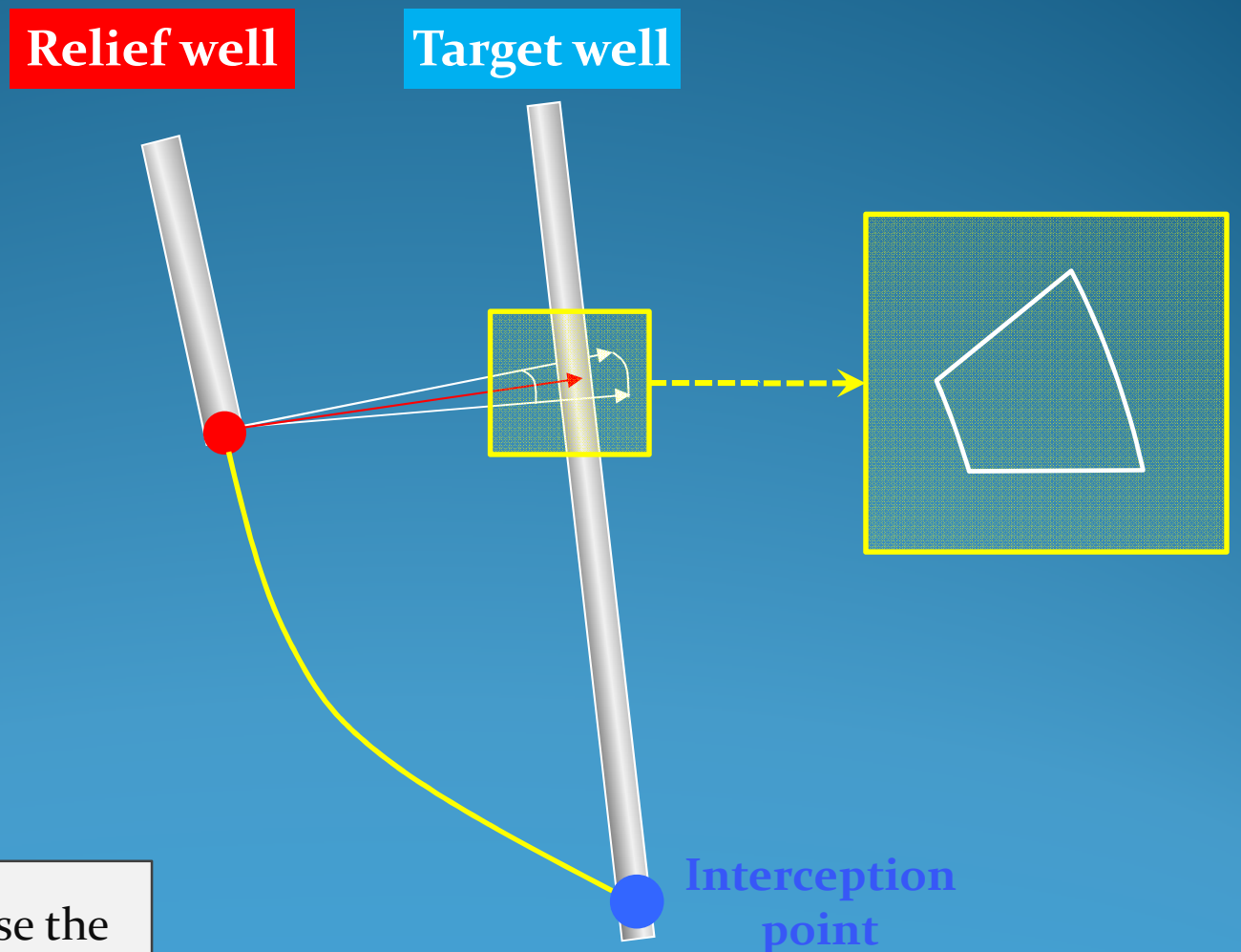


Plan Forward Challenges



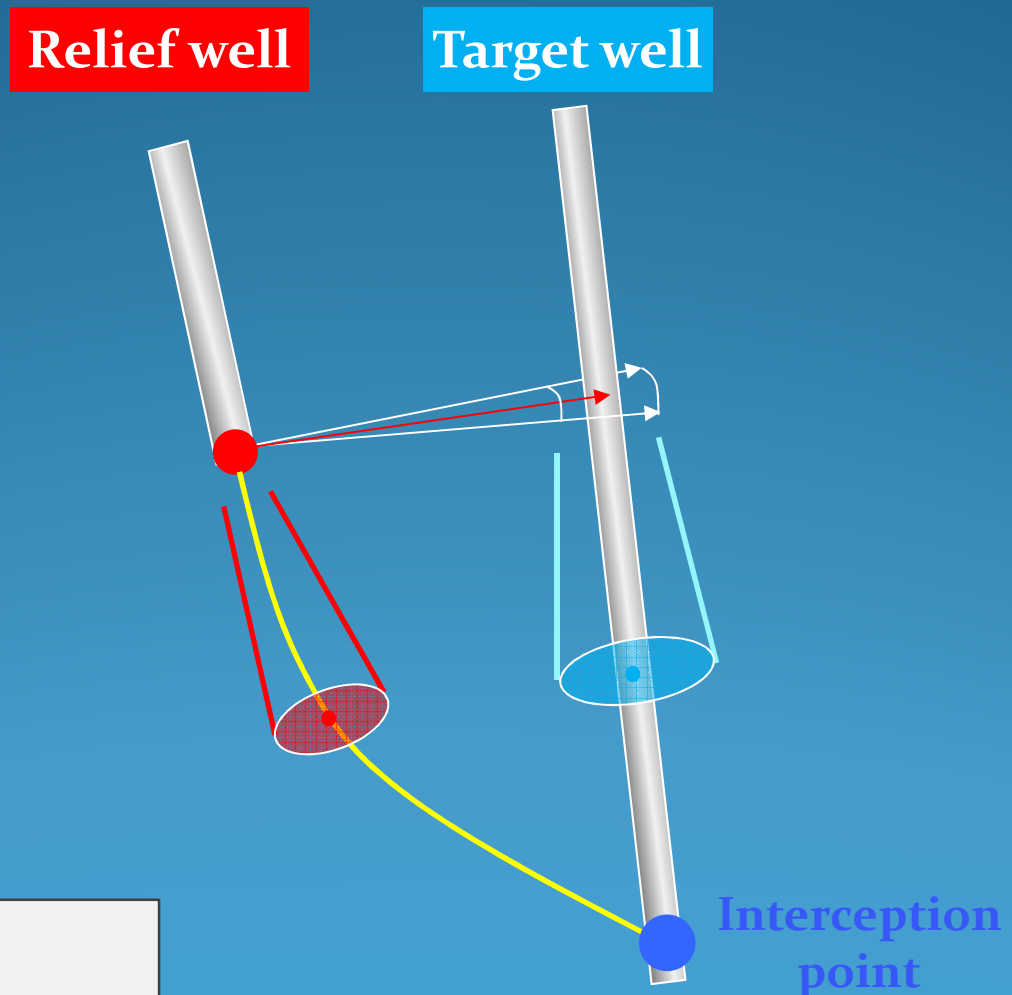
Challenge ❶ : Need for a new plan after each ranging run

Plan Forward Challenges



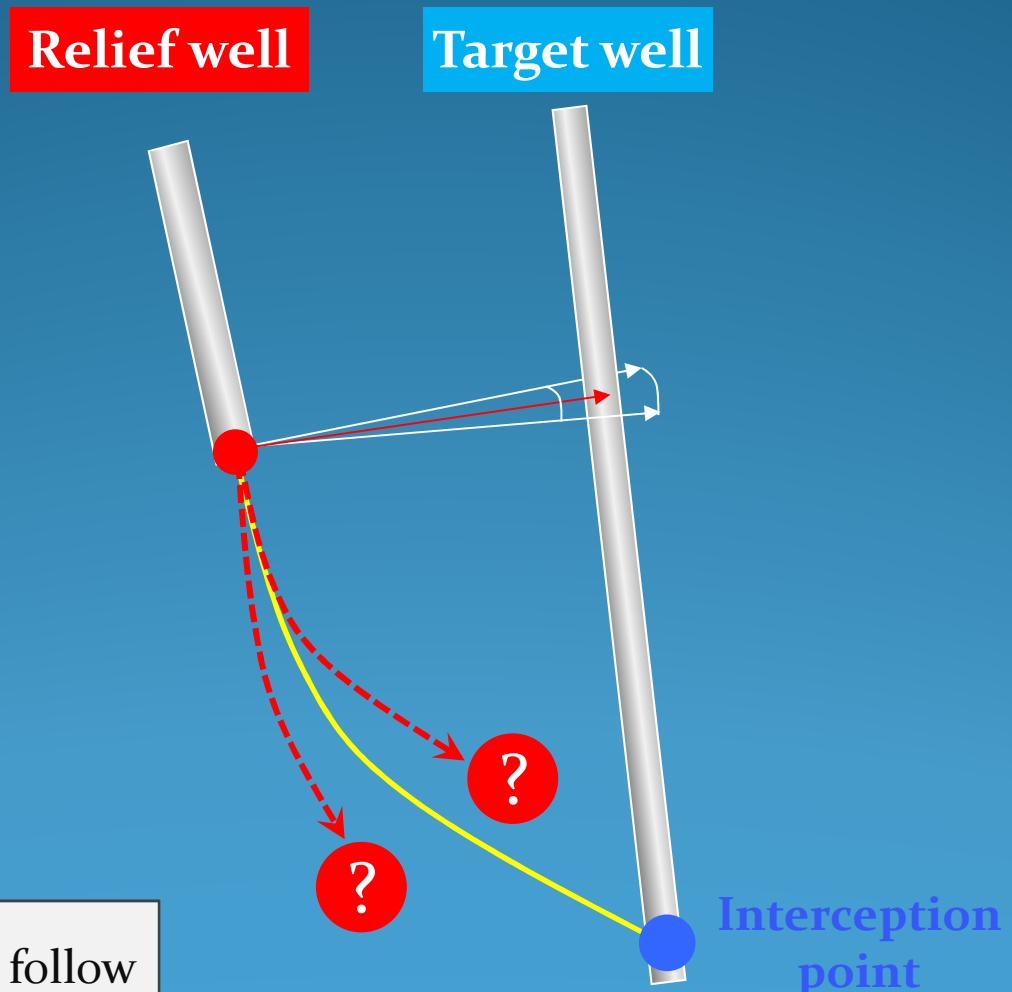
Challenge ❷ : How to use the ranging uncertainty window ?

Plan Forward Challenges



Challenge ❸ : How to propagate Error Models ?

Plan Forward Challenges



Challenge ❹ : Ability to follow the plan (Directional Control)

Plan Forward Challenges

1. Need for a new plan after each ranging run
2. How to use the ranging uncertainty window ?
3. How to propagate Error Models ?
4. Ability to follow the plan (Directional Control)

Objectives

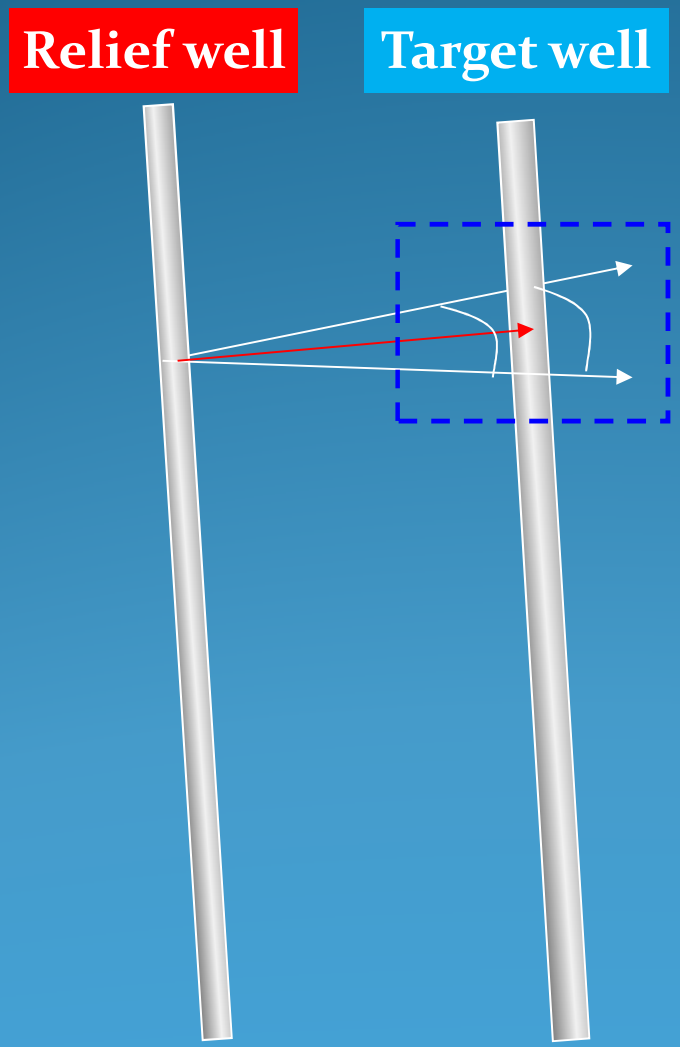
α Address how to apply collision avoidance rules in case of Active Magnetic Ranging

β Highlight criteria that should be considered in order to define the distance between successive rangings

Outline

1. Positioning of the problem
2. Ranging results interpretation
3. Planning forward after each ranging
4. Conclusions

Ranging interpretation

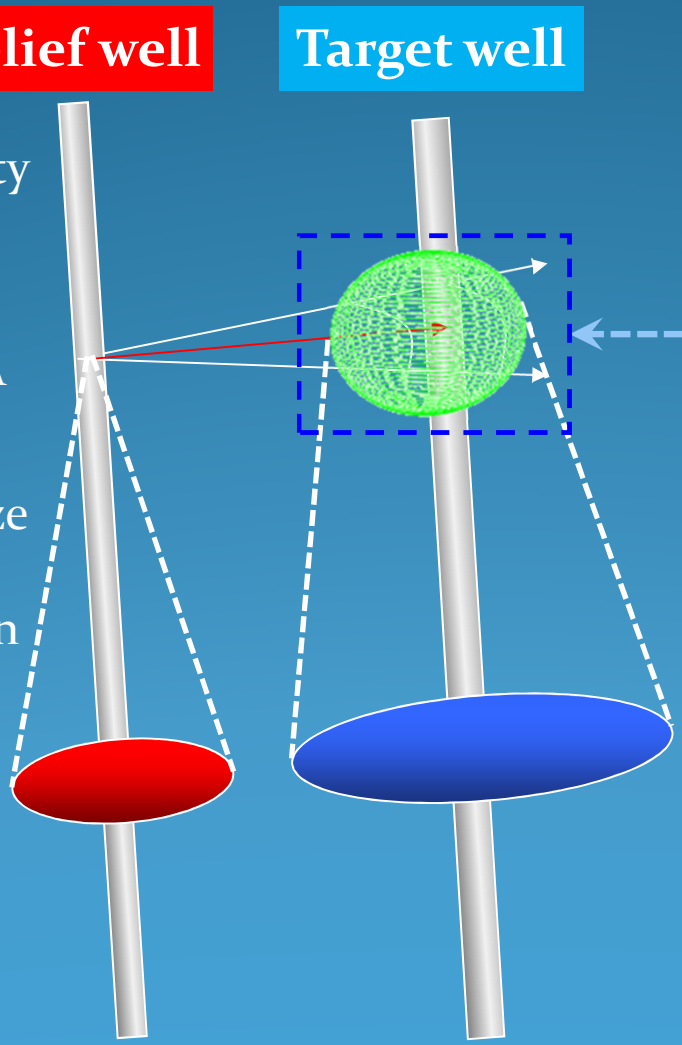


Aim: Modeling the Ranging results to be compliant with the ISCWSA formalism

- Combining the ranging uncertainty window and ISCWSA Error Models will allow determining more accurate & realistic uncertainty envelope
- The new envelope is critical to determine the depth of the next ranging

Ranging interpretation

- Initialize the position uncertainty from the last detection point
- Propagate ISCWSA Error Model
- No need to initialize the PU, all starting uncertainties are on the Target well



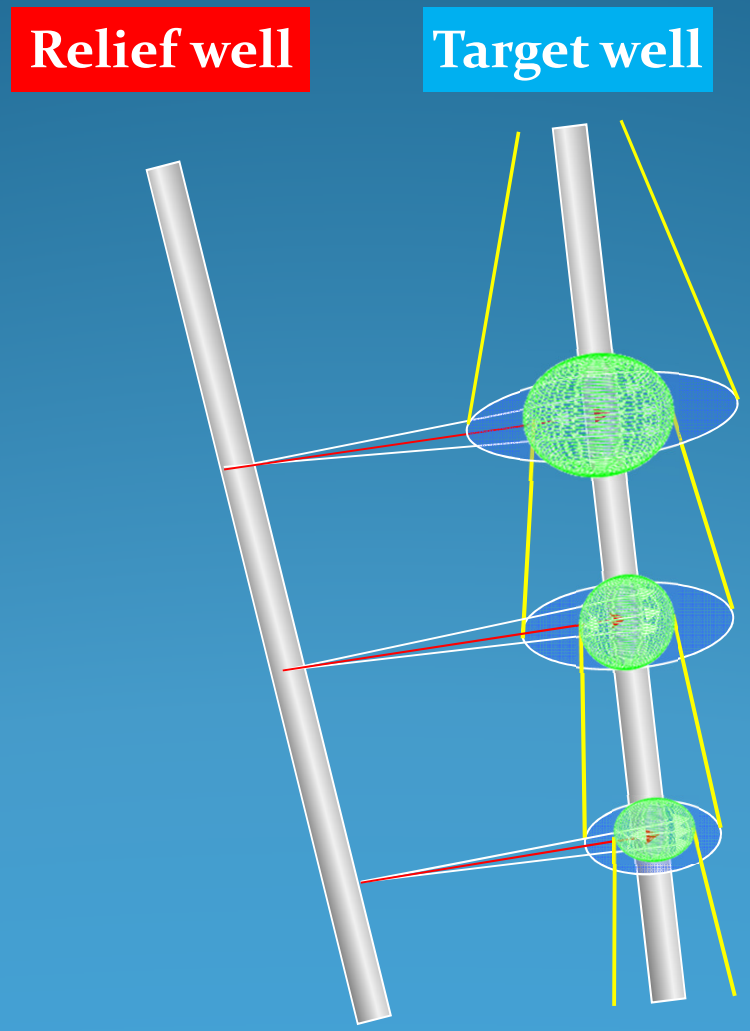
Ranging uncertainty window

Sphere of uncertainty

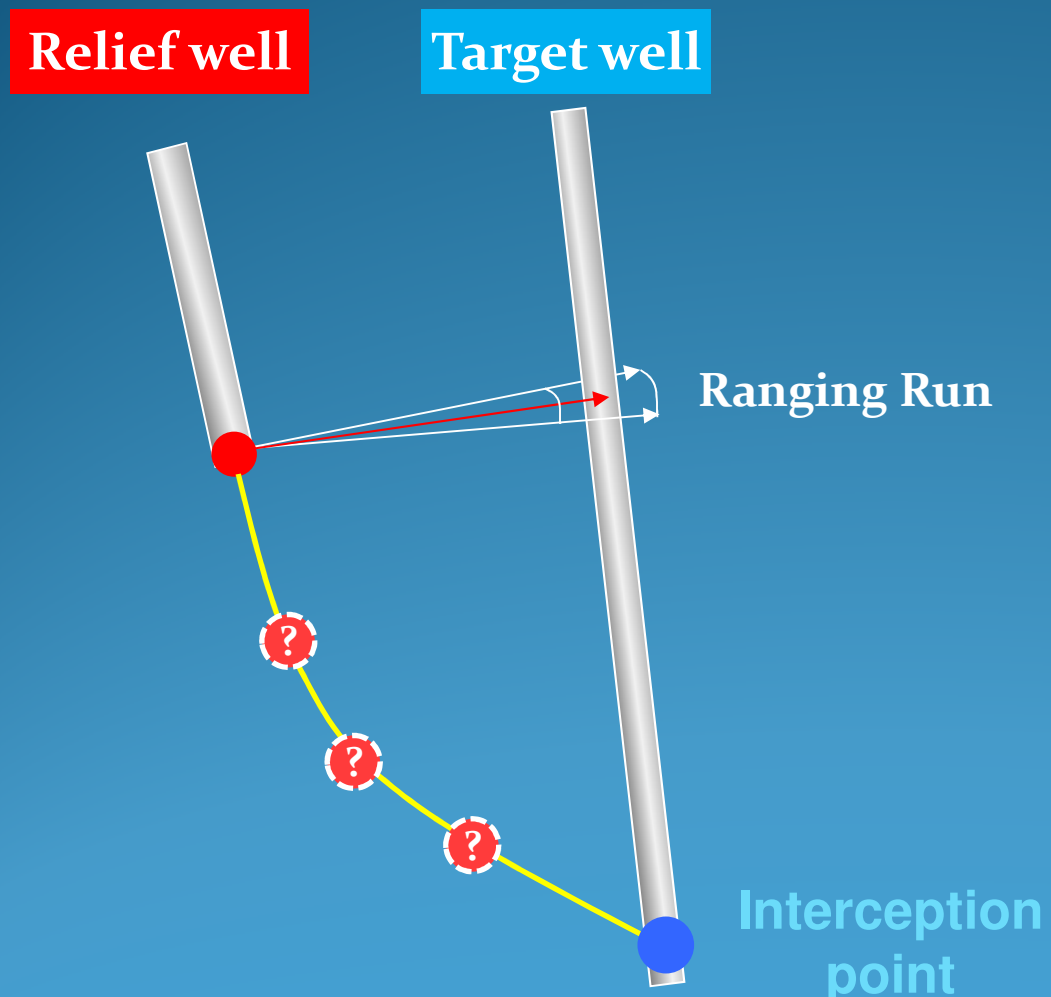
Propagating the uncertainty envelope on the Target well:

- Initialize the position uncertainty from the last ranging point at the ranging uncertainty model (sphere of uncertainty)
- Propagate the ISCWSA Error Model

Ranging interpretation



Plan forward



One question

"When To Stop For The Next Ranging Run ?"

Two answers !!

- Collision avoidance considerations
- Ability to intercept at the intended window

Plan forward

"When To Stop For The Next Ranging Run ?"

Collision avoidance considerations

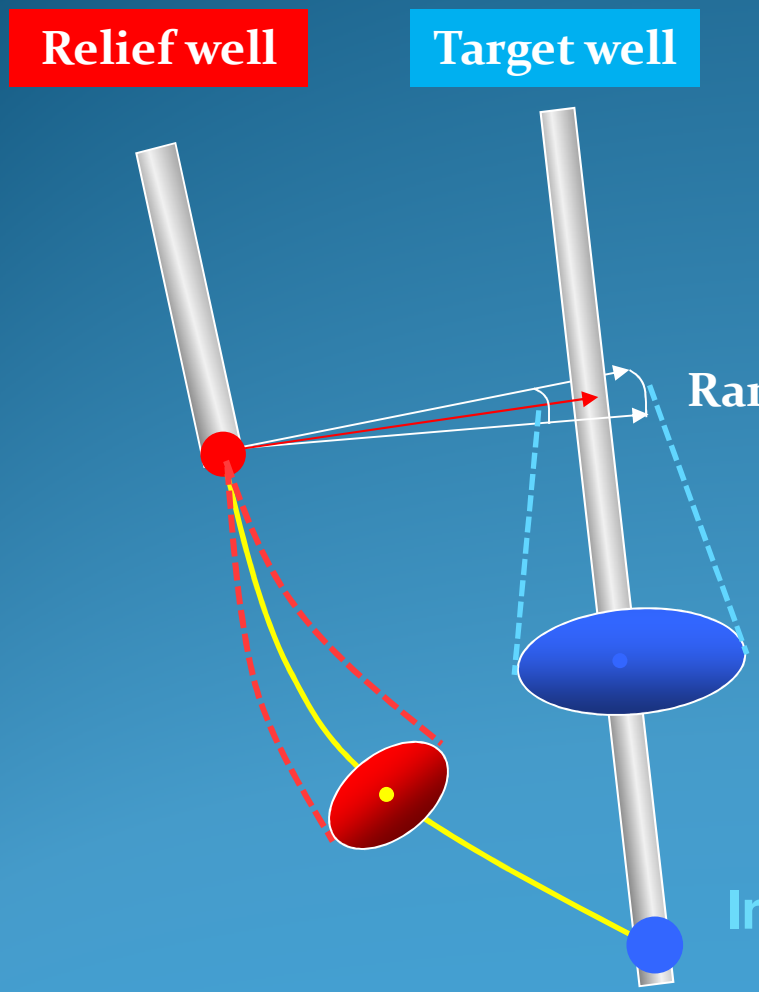
Calculate safe distance to drill (D1) with no risk of premature interception with the Target well

Ability to intercept at the intended window

Calculate maximum distance that could be drilled and be able to re-plan under specific operational conditions (Iterative process ➔ distance D2)

Decision making

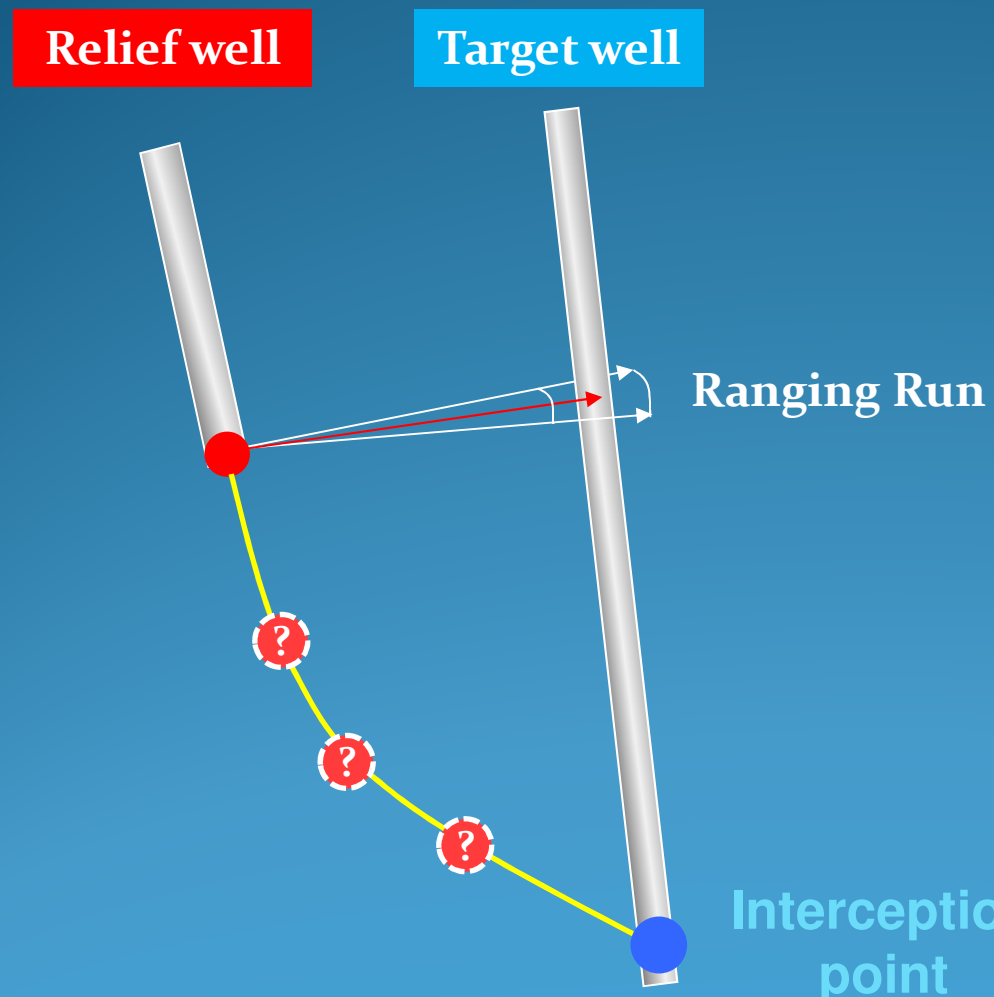
Plan forward



Modeling the ranging uncertainty allows propagating the PU and applying standard anticollision policies

- Collision avoidance considerations
- Ability to intercept at the intended window

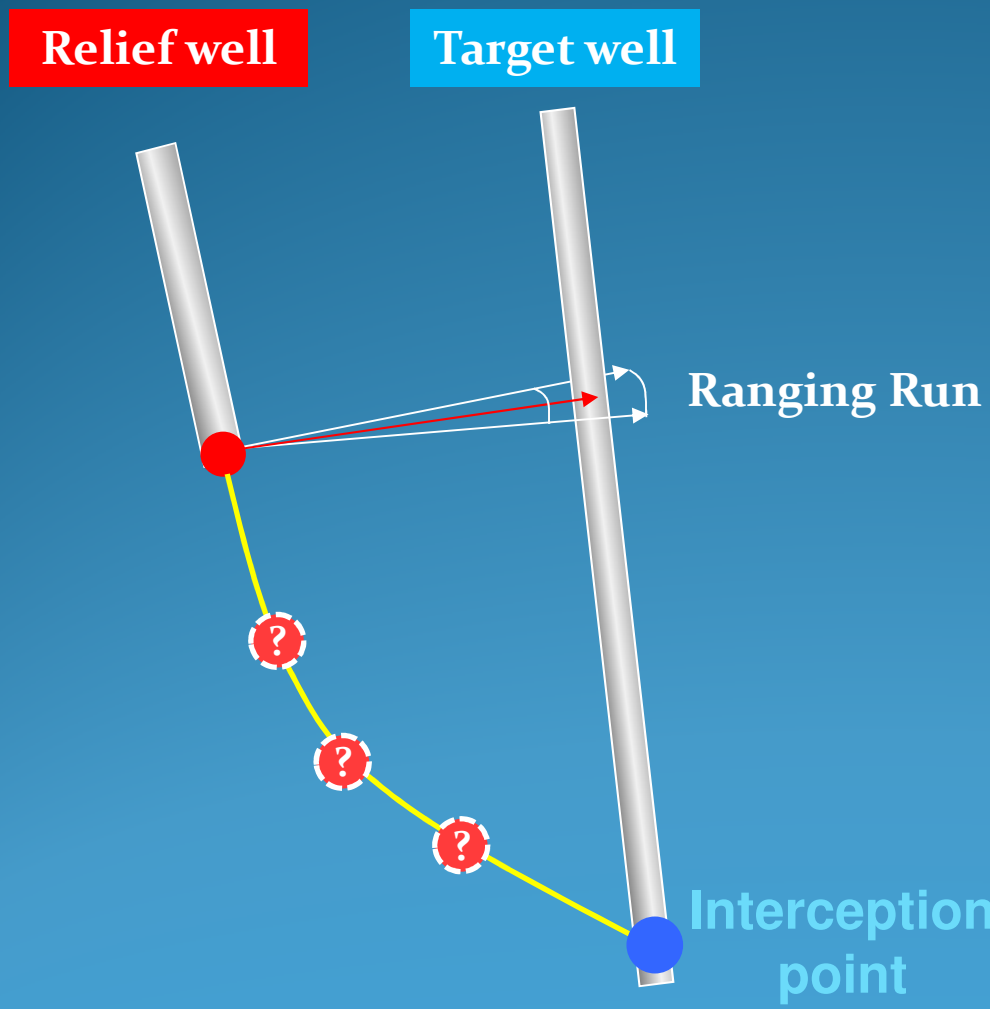
Plan forward



We don't want to go neither too far nor too close in order to be able to intercept at the intended interception window under specific operational conditions

- Collision avoidance considerations
- Ability to intercept at the intended window

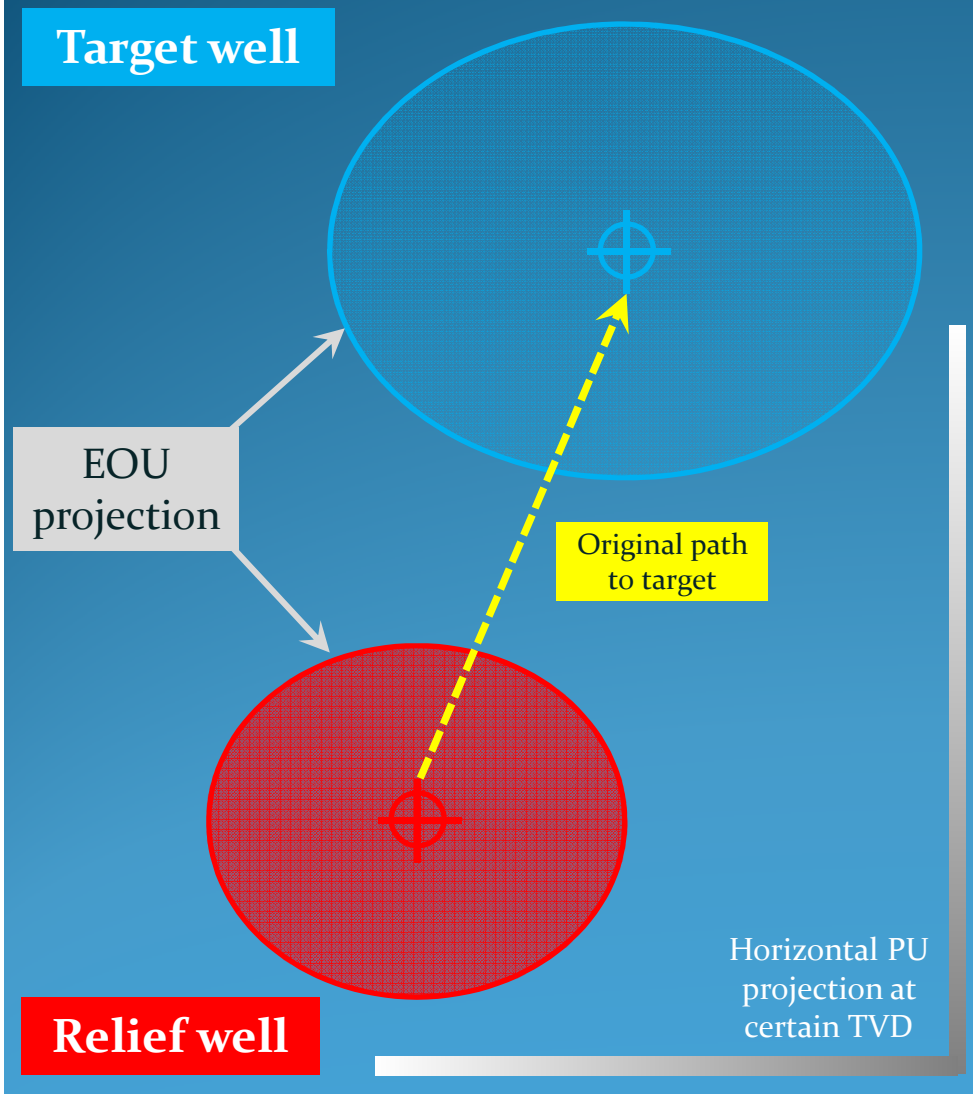
Plan forward



Operational context

- Directional capabilities
- Interception TVD window
- Inclination to target
- Incidence angle at interception
- Alignment with the Target
- Casing shoe position
- ● ● ●

Plan forward



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- Directional capabilities
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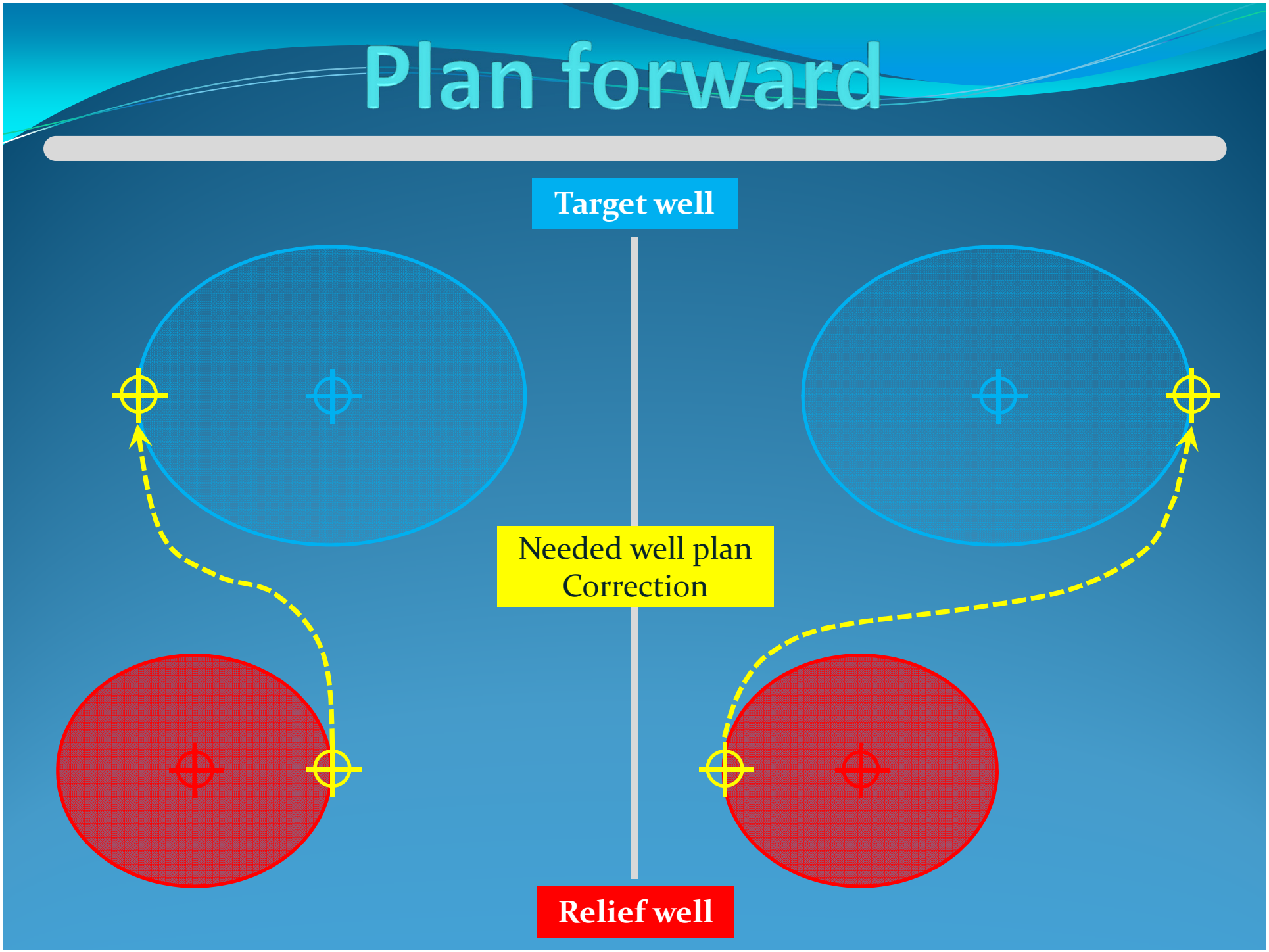
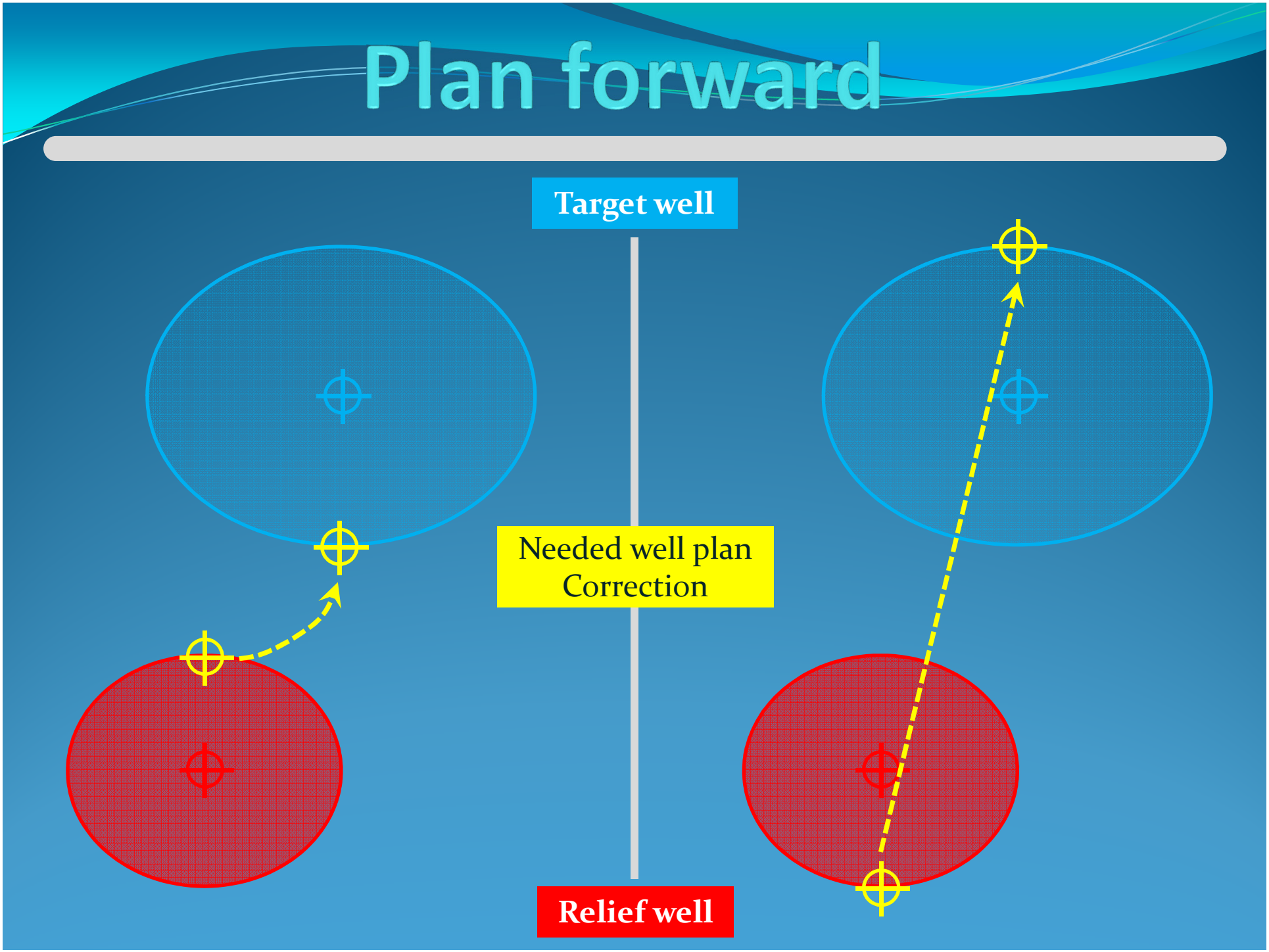
Worst case analysis

Plan forward



Plan forward



Conclusions

- The ranging uncertainty could be interpreted and modeled to be complying with ISCWSA formalism
- From well planning stand point, distance between successive ranging runs should take into account:
  - *Collision avoidance considerations*
  - *Ability to re-plan and intercept the target at the intended location with respect to specific operational conditions (directional control | ranging requirements | borehole quality …)*