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Section Referenced:	9.11.1.2.4
Subject:	Repairs within the critical zone Better subject line???: Bottom Plate Replacement in Critical Zone
Background:	<p>There is an area in the critical zone that is larger than a maximum 24" welded-on patch plate will cover. (9.11.1.2.i) So this means we go to the requirements of 9.11.1.2.4 (more extensive repairs are required within the critical zone). Which states "the bottom plate welded to the shell shall be cut out and a new plate shall be installed." My opinion is that this means the entire sketch plate shall be cut out and replaced with new material, or a minimum of 72" shall be replaced due to being a sketch plate or as API 650, 5.4.1 states, "bottom plates on which the shell rests" shall have a nominal width of not less than 72". I get back to the requirements of API 650, because in 9.11.1.2.4, states weld spacing requirements shall be in accordance with 9.11.2.4. 9.11.2.4 - Says its for a new bottom installation, and shall meet all requirements of API 650. I know this is not a new bottom replacement, its only one area to large to patch so it requires replacing the area. Going back to API 650, 5.4.1 does allow a sketch plates to be smaller than 72", if agreed to by the Purchaser. RECOMMENDED WORDING: In my opinion section 9.11.2.4 should be revised to include the following, "Installation of a new tank bottom, after removal of the existing tank bottom, or the replacement of a sketch plate that the shell rests upon, shall meet all requirements of API 650."</p>
Question:	<p>Does API 653, 9.11.1.2.4 require if an area in the critical zone is larger than a maximum 24" welded-on patch plate will cover ("more extensive repair"), the entire sketch plate shall be cut out and replaced with new material, or a minimum of 72" shall be replaced, on which the shell rests, unless a smaller length of area is agreed upon to by the Purchaser? In my opinion, the answer is "yes" to above question.</p>
DGM question restatement	<p>Q1) If the dimension along the shell required for a weld-on patch to cover a repair area in the critical zone is longer than the 24" limit in 9.11.1.2(i), and the bottom plate needing repair has one end rectangular, then must the width of the rectangular end of the replacement plate mandated by 9.11.1.2.4 be at least 72" (unless otherwise agreed to by the purchaser) in order to conform to API 650, 5.4.1?</p> <p>Q2) If the dimension along the shell required for a weld-on patch to cover a repair area in the critical zone is longer than the 24" limit in 9.11.1.2(i), and the bottom plate needing repair has NO rectangular end, then must the width of the replacement plate mandated by 9.11.1.2.4 be at least 72" (unless otherwise agreed to by the purchaser) in order to conform to API 650, 5.4.1?</p>
Draft reply	R1) Yes, API 650 equivalence is mandated by 9.1.1 unless specifically modified by an

	<p>API 653 statement. R2) No, API 650, 5.4.1 has no limitation on the width of a bottom plate that has no rectangular end other than limitations implied by other rules such as distance of three-plate laps from the shell in API 650, 5.1.5.4.2)</p>
<p>Need agenda item?</p>	<p>No</p>

Quotations from API 653 and API 650 for reviewer’s convenience.

API 653, 9.1.1 The basis for repairs and alterations shall be an API 650 equivalence.

API 653, 9.11.1.2 Repairs within the Critical Zone

The use of welded-on patch plates is permitted for repairing a portion of tank bottoms within the critical zone (see 3.10 for definition) provided 9.11.1.1 requirements and the following additional requirements are met.

- i) The maximum dimension along the shell for welded-on patch plates in the critical zone is 24 in.

API 653, 9.11.1.2.4 If more extensive repairs are required within the critical zone than those listed in 9.11.1.2, the bottom plate welded to the shell shall be cut out and a new plate shall be installed. Weld spacing requirements shall be in accordance with 9.11.2.4, and API 650, Section 5.1.5.4 and Section 5.1.5.5. The shell-to-bottom weld shall be removed and replaced for a minimum distance of 12 in. on each side of the new bottom plate.

API 653, 9.11.2.4 Installation of a new tank bottom, after removal of the existing tank bottom, shall meet all requirements of API 650. Except as permitted in 9.11.2.7, existing shell penetrations shall be raised or their penetration reinforcing plates modified if the elevation of the new bottom results in inadequate nozzle reinforcement (see Figure 9.8 and API 650, Section 5.7.2) or if the weld spacing requirements given in API 650, Section 5.7.3 are not met. For tanks with shell plate of unknown toughness as defined in Section 3, new weld joints in the bottom or annular ring shall be spaced at least the greater of 3 in. or 5t from existing vertical weld joints in the bottom shell course, where t is the thickness of the bottom shell course, in inches.

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API 650, 5.4.1 All bottom plates shall have a corroded thickness of not less than 6 mm (0.236 in.) [49.8 kg/m² (9.6 lbf/ft²) (see 4.2.1.2)]. Unless otherwise agreed to by the Purchaser, all rectangular and sketch plates (bottom plates on which the shell rests that have one end rectangular) shall have a nominal width of not less than 1800 mm (72 in.)

API 650, 5.1.5.4 Lap-Welded Bottom Joints

5.1.5.4.1 Lap-welded bottom plates shall be reasonably rectangular. Additionally, plate may be either square cut or may have mill edges. Mill edges to be welded shall be relatively smooth and uniform, free of deleterious deposits, and have a shape such that a full fillet weld can be achieved. Unless otherwise specified by the Purchaser, lap welded plates on sloped bottoms shall be overlapped in a manner to reduce the tendency for liquid to puddle during draw-down.

5.1.5.4.2 Three-plate laps in tank bottoms shall be at least 300 mm (12 in.) from each other, from the tank shell, and from joints between annular plates and the bottom. A three-plate lap is created where three plates come together and all plates are joined to one another by lap welds. A location where two bottom plates are lap-welded to each other and are lapped onto or under an annular plate constitutes a three-plate lap, but lapping a single bottom plate onto or under a butt-welded annular plate splice does not constitute a three-plate lap weld since the two annular plates are not joined together by a lap weld. Lap joint connections to butt-welded annular plates are illustrated in Figure 5.3d

5.1.5.4.3 Bottom plates need to be welded on the top side only, with a continuous full-fillet weld on all seams. Lap-welded bottom plates under the bottom shell ring shall have the outer ends of the joints fitted and lap-welded to form a smooth bearing surface for the shell plates, as shown in Figure 5.3b. Lap-welded bottom plates shall be seal-welded to each other on the exposed outer periphery of their lapped edges

API 650, 5.1.5.5 Butt-Welded Bottom Joints

Butt-welded bottom plates shall have their parallel edges prepared for butt welding with either square or V grooves. Butt-welds shall be made using an appropriate weld joint configuration that yields a complete penetration weld. Typical permissible bottom butt-welds without a backing strip are the same as those shown in Figure 5.1. The use of a backing strip at least 3 mm (1/8 in.) thick tack welded to the underside of the plate is permitted. Butt-welds using a backing strip are shown in Figure 5.3a. If square grooves are employed, the root openings shall not be less than 6 mm (1/4 in.). A metal spacer shall be used to maintain the root opening between the adjoining plate edges unless the Manufacturer submits another method of butt-welding the bottom for the Purchaser's approval. Three-plate joints in the tank bottom shall be at least 300 mm (12 in.) from each other and from the tank shell.