		Agenda Item 653-2062
Subject:	**Repad Spacing in a Replacement Bottom**	
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Purpose:		
Source:	Inquiry 653-2023-F2	
Revision:	*0 Note: red shows ALL changes from current publication* *1 All Rev 1 changes shown in Orange. Only change was adding titles of the annexes C and H.*	
Date:	10/10/23	
Impact:	Provides clarity as to whether the weld spacing and NDE requirements of 9.11.3.1 must be satisfied when a tank bottom is completely replaced in an existing tank?	
Background:	Inquiry 653-2023-F2 posed the following scenario and question. A new tank bottom is being installed per API 650 in an API 653 repair tank. Striker pads (landing pads) and support pads will be required on the tank bottom. A new tank bottom is being installed per API 650 (API 653 9.11.2.4) in an API 653 repair tank. The old floor was completely removed. Do the additional welded-on pads on the new bottom require the NDE and spacing as described in API 653 9.11.3? A straw poll at the 2023 Spring Standards Conference showed a 15-3 majority in favor of revising/clarifying 9.11 to state that additional NDE was needed on existing bottoms but only NDE required by API 650 (VE and VB) was required on new replacement bottoms.	
Current wording:	**9.11.1 General Repair Requirements** **9.11.2 Replacement of Tank Bottom Plates** **. . .** **9.11.2.2** New bearing plates for fixed roof support columns shall be installed. For steel floating roof legs, steel pads or other means shall be used to distribute the loads on the bottom of the tank and provide a wear surface. If pads are used, they shall be continuously welded to the tank bottom. For aluminum floating roofs, the pads may be omitted if the owner operator approves and new austenitic stainless steel or acceptable nonmetallic (e.g., Teflon) spacers are installed to isolate legs from the carbon steel bottom. For aluminum floating roofs, austenitic stainless steel or acceptable nonmetallic (e.g., Teflon) spacers may installed to isolate legs from the carbon steel bottom instead of welded pads if the spacers will not damage bottom coatings, there is no evidence of corrosion damage from such spacers on the previous bottom, and if the owner/operator approves. **. . .**	

	9.11.2.5 Replacement of portions of an existing tank bottom (entire rectangular plates or large segments of plates) not within the critical zone (see 3.10 for definition) are permitted under the same rules that govern installation of bottoms in new tank construction per API 650, Sections 5.4 and 5.5. **9.11.3 Additional Welded-on Plates** **9.11.3.1** If other welded-on plates, such as wear, isolation, striker, and bearing plates, are to be added to tank bottoms, they shall be installed in accordance with 9.11.1, and examined in accordance with 12.1.7. For these additional welded-on plates, if the lap-weld spacing requirements in Figure 9.13 are not met, magnetic particle (MT) or liquid penetrant (PT) examination is required for the exposed welds, or portions of welds, failing to meet minimum spacing criteria. See Section 12 for acceptance requirements. **9.11.3.2** Welded-on plates that fall within the critical zone (see 3.10 for definition) shall be installed in accordance with 9.11.1.2 and comply with all of its requirements.

Revised Proposal:	9.11.3 has been moved to section 9.11.1 and labelled 9.11.1.4. Numbering of the section was revised to accommodate the insertion of the new section. The green is the original language that was moved from 9.11.3. The red is new language. It follows 9.11.1.3 which is direction for welded on patch plates on an existing bottom. **9.11.1.4** If other welded-on plates, such as wear, isolation, striker, and bearing plates, are to be added to existing tank bottoms, they shall be installed in accordance with the following requirements. a) Welded-on plates shall be installed in accordance with 9.11.1~~,~~ and examined in accordance with 12.1.7. ~~For these additional welded-on plates, if~~ the lap-weld spacing requirements in Figure 9.13 are not met, magnetic particle (MT) or liquid penetrant (PT) examination is required for the exposed welds, or portions of welds, failing to meet minimum spacing criteria. See Section 12 for acceptance requirements. b) Additionally, ~~W~~welded-on plates that fall within the critical zone (see 3.10 for definition) shall be installed in accordance with 9.11.1.2 and comply with all of its requirements. Numbers below renumber for the new 9.11.1.4 (note that you cannot see the strike mark in the "4" below. The new number is 9.11.1.5 9.11.1.~~4~~5 Unacceptable indications such as cracks, gouges, tears, and corroded areas discovered in bottom plates, located outside the critical zone, may be repaired by deposition of weld metal followed by examination and testing in accordance with 12.1.7.3. Surface irregularities and contamination within the area to be repaired shall be removed before welding. 9.11.1.~~5~~6 The repair of sumps located within the critical zone shall be in accordance with 9.11.1.2. 9.11.1.~~6~~7 The repair of corroded plates in the critical zone is limited to pit welding or overlay welding as noted in this section. The weld repair of bottom plate corrosion is permitted if all of the following conditions are satisfied. a) The sum of the pit dimensions along an arc parallel to the shell-to-bottom joint does not exceed 2 in. in an 8-in.length. b) There must be sufficient remaining bottom plate thickness for completion of a sound weld and to avoid burn through. The minimum acceptable bottom plate thickness for weld repairs is 0.10 in. A lesser thickness is permitted for weld repairs only if reviewed and approved by an engineer experienced in storage tank design and repair. c) All weld repairs shall be ground flush with the surrounding plate material and be examined in accordance with 12.3.3.4. 9.11.2 Replacement of Tank Bottom Plates (this section talks mostly about new bottom installations) 9.11.2.2 New bearing plates for fixed roof support columns shall be installed as

	required in API 650. For steel floating roof legs, steel pads or other means shall be used to distribute the loads on the bottom of the tank and provide a wear surface. If pads are used, they shall be continuously welded to the tank bottom. Installation shall be per API 650 Annex C, External Floating Roofs, or Annex H, Internal Floating Roofs. For aluminum floating roofs, the pads may be omitted if the owner operator approves and new austenitic stainless steel or acceptable nonmetallic (e.g., Teflon) spacers are installed to isolate legs from the carbon steel bottom. For aluminum floating roofs, austenitic stainless steel or acceptable non-metallic (e.g., Teflon) spacers may installed to isolate legs from the carbon steel bottom instead of welded pads if the spacers will not damage bottom coatings, there is no evidence of corrosion damage from such spacers on the previous bottom, and if the owner/operator approves. The stricken language below is just showing that 9.11.3 was removed. This is the language that was moved to 9.11.1.4 ~~9.11.3 Additional Welded-on Plates~~ ~~9.11.3.1 If other welded-on plates, such as wear, isolation, striker, and bearing plates, are to be added to tank bottoms, they shall be installed in accordance with 9.11.1, and examined in accordance with 12.1.7. For these additional welded-on plates, if the lap-weld spacing requirements in Figure 9.13 are not met, magnetic particle (MT) or liquid penetrant (PT) examination is required for the exposed welds, or portions of welds, failing to meet minimum spacing criteria. See Section 12 for acceptance requirements.~~ ~~9.11.3.2 Welded-on plates that fall within the critical zone (see 3.10 for definition) shall be installed in accordance with 9.11.1.2 and comply with all of its requirements.~~
Rationale:	New tank bottoms do not require additional NDE above VE and VB on tank bottom pad plates during API 650 construction. To be consistent, new 653 tank bottoms with new steel should not require additional NDE (MT or PT). Modified flow and revised wording to clarify that existing tank bottoms need additional NDE if the weld spacing does not meet patch plate weld spacing and clarified that new bottoms should refer to API 650. Below is an outline of the current flow of 9.11 prior to modification with this agenda item. 9.11.1 Repairing a Portion of Lap-Welded or Butt-welded Tank Bottoms 9.11.1.1 General Repair Requirements 9.11.1.2 Repairs within the Critical Zone 9.11.1.3 Use of welded-on patch plates 9.11.1.4 Bottom Plate Repair 9.11.1.5 Repair of Sumps 9.11.1.6 Repair of corroded plates in the critical zone 9.11.2 Replacement of Tank Bottom Plates 9.11.2.1 Requirements for replacement bottom over existing bottom 9.11.2.2 New bearing plates, steel pads 9.11.2.3 Separating tank shell when removing the bottom 9.11.2.4 Installation of a new tank bottom

	9.11.2.5 Replacement portions of an existing bottom 9.11.2.6 Discusses removal of bottom for CP and Leak detection 9.11.2.7 Reduced cornerweld to repad weld spacing for certain tanks 9.11.3 Additional Welded on Plates Comments regarding welded on pads in API 650 **API 650** 5.10.4.7 Roof support columns shall be provided at their bases with details that provide for the following. a) Load Distribution: Column loads shall be distributed over a bearing area based on the specified soil bearing capacity or foundation design. The pressure applied by the tank liquid height need not be considered when sizing column bases to distribute loads. If an unstiffened horizontal plate is designed to distribute the load, it shall have a nominal thickness of not less than 12 mm (1/2 in.). Alternatively, the column load may be distributed by an assembly of structural beams. The plate or members shall be designed to distribute the load without exceeding allowable stresses prescribed in 5.10.3.1. b) Corrosion and Abrasion Protection: At each column a wear plate with a nominal thickness of not less than 6 mm (1/4 in.) shall be welded to the tank bottom with a 6 mm (1/4 in.) minimum fillet weld. A single adequate thickness plate may be designed for the dual functions of load distribution and corrosion/abrasion protection. 7.3.3 Examination and Testing of the Tank Bottom – does not comment on welded on plates separately from bottom welds C.3.10.5 Roof legs shall have matching steel landing pads continuous full-fillet welded to the tank bottom with minimum dimensions of 10-mm (3/8-in.) thickness by 350-mm (14-in.) diameter. The centerline of the legs shall coincide with the centerline of the landing pads. No NDE included H.4.6.6 Steel pads or other means shall be used to distribute the loads on the bottom of the tank and provide a wear surface. With the Purchaser's approval, pads may be omitted if the tank bottom will support the live load plus the dead load of the floating roof. If pads are used, they shall be continuously welded to the tank bottom. No NDE included Annex T – NDE Requirements Summary – No NDE for welded on pads other than VE "All fillet welds" and VB "Bottom welds . . . "