

| Selection step               | $0\ell + 2\tau_h$                                                                                                    | $1\ell + 1\tau_h$                                                                                                     |
|------------------------------|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| Targeted $t\bar{t}H$ decays  | $t \rightarrow b\bar{q}q', t \rightarrow b\bar{q}q'$ with<br>$H \rightarrow \tau\tau \rightarrow \tau_h\nu\tau_h\nu$ | $t \rightarrow b\bar{q}q', t \rightarrow b\bar{q}q'$ with<br>$H \rightarrow \tau\tau \rightarrow \ell\nu\nu\tau_h\nu$ |
| Trigger                      | Double- $\tau_h$ trigger                                                                                             | Single-lepton<br>and lepton+ $\tau_h$ triggers                                                                        |
| Lepton $p_T$                 | —                                                                                                                    | $p_T > 30$ (e) or 25 GeV ( $\mu$ )                                                                                    |
| Lepton $\eta$                | —                                                                                                                    | $ \eta  < 2.1$                                                                                                        |
| $\tau_h p_T$                 | $p_T > 40$ GeV                                                                                                       | $p_T > 30$ GeV                                                                                                        |
| $\tau_h \eta$                |                                                                                                                      | $ \eta  < 2.1$                                                                                                        |
| $\tau_h$ identification      | loose                                                                                                                | medium                                                                                                                |
| Charge requirements          | $\sum_{\tau_h} q = 0$                                                                                                | $\sum_{\ell, \tau_h} q = 0$                                                                                           |
| Multiplicity of central jets |                                                                                                                      | $\geq 4$ jets                                                                                                         |
| b tagging requirements       | $\geq 1$ tight b-tagged jet or                                                                                       | $\geq 2$ loose b-tagged jets                                                                                          |
| Dilepton invariant mass      |                                                                                                                      | $m_{\ell\ell} > 12$ GeV                                                                                               |

| Selection step               | $1\ell + 2\tau_h$                                                                                                            | $2\ell + 2\tau_h$                                                                                                                |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Targeted $t\bar{t}H$ decays  | $t \rightarrow b\bar{\ell}\nu, t \rightarrow b\bar{q}q'$ with<br>$H \rightarrow \tau^+\tau^- \rightarrow \tau_h\nu\tau_h\nu$ | $t \rightarrow b\bar{\ell}\nu, t \rightarrow b\bar{\ell}\nu$ with<br>$H \rightarrow \tau^+\tau^- \rightarrow \tau_h\nu\tau_h\nu$ |
| Trigger                      | Single-lepton<br>and lepton+ $\tau_h$ triggers                                                                               | Single-<br>and double-lepton triggers                                                                                            |
| Lepton $p_T$                 | $p_T > 30$ (e) or 25 GeV ( $\mu$ )                                                                                           | $p_T > 25 / 10$ (15) GeV (e)                                                                                                     |
| Lepton $\eta$                | $ \eta  < 2.1$                                                                                                               | $ \eta  < 2.5$ (e) or 2.4 ( $\mu$ )                                                                                              |
| $\tau_h p_T$                 | $p_T > 30 / 20$ GeV                                                                                                          | $p_T > 20$ GeV                                                                                                                   |
| $\tau_h \eta$                | $ \eta  < 2.1$                                                                                                               | $ \eta  < 2.3$                                                                                                                   |
| $\tau_h$ identification      | medium                                                                                                                       | medium                                                                                                                           |
| Charge requirements          | $\sum_{\ell, \tau_h} q = \pm 1$                                                                                              | $\sum_{\ell, \tau_h} q = 0$                                                                                                      |
| Multiplicity of central jets | $\geq 3$ jets                                                                                                                | $\geq 2$ jets                                                                                                                    |
| b tagging requirements       | $\geq 1$ tight b-tagged jet or                                                                                               | $\geq 2$ loose b-tagged jets                                                                                                     |
| Missing transverse momentum  | —                                                                                                                            | $L_D > 0 / 30 / 45$ GeV <sup>†</sup>                                                                                             |
| Dilepton invariant mass      |                                                                                                                              | $m_{\ell\ell} > 12$ GeV                                                                                                          |

<sup>†</sup> See text for a complete description of this requirement.