|  |
| --- |
| **BREVET DE TECHNICIEN SUPÉRIEUR**  **ENVIRONNEMENT NUCLÉAIRE** |

SESSION 2018

**\_\_\_\_\_\_**

###### Durée : 4 heures

Coefficient : 3

**\_\_\_\_\_\_**

ÉPREUVE E4 :  
Modélisation et choix techniques  
en environnement nucléaire

SOUS-ÉPREUVE U4.1 :  
Pré-étude et modélisation

CORRIGÉ

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **60,0** | **analyse du barème sur feuille "statistiques"** | | | | | |  |  |  |
|  | **1/** | **Traitement du point chaud 10,5 pts** | | | |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| 1 |  | **1-1/** |  |  | 5826Fe + 10n |  | 5926Fe |  |  |
|  |  |  |  |  |  |  |  |  |  |
| 1 |  |  |  |  | 5927Co + 10n |  | 5926Fe + 11p |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  | **1-2/** |  |  | 5926Fe est émetteur - | |  |  |  |
| 1 |  |  |  |  | S'il était émetteur +, une raie  à 511 keV serait citée | | | |  |
| 1 |  |  |  |  | 5926Fe |  | 5927Co + 0-1e + | 00 |  |
|  |  |  |  |  | (5927Co est stable) | |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  | **1-3/** |  |  | A0 = | 180 | MBq |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | | 1 | 2 | 3 |
|  |  |  |  |  | E en keV | | 192 | 1 099 | 1 292 |
|  |  |  |  |  | I en % | | 3% | 56% | 44% |
|  |  |  |  |  | D° en µGy/h | | 0,1 | 14,4 | 13,3 |
|  |  |  |  |  | à 1 m | | 27,8 | | |
|  |  |  |  |  | H°1 en µSv/h | | 27,8 | | |
| 2 |  |  |  |  | à 1 m | |
|  |  |  |  |  |  |  |  |  |  |
| 1 |  |  |  |  | H°1 = D°.WR | avec | WR = 1 | car  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  | **1-4/** |  |  | H°1 = | 27,8 | µSv/h à 1 m |  |  |
|  |  |  |  |  | x = | 13 | mm |  |  |
|  |  |  |  |  | Emax = | 1 292 | keV |  |  |
|  |  |  |  |  |  = | 11,3 | g/cm3 |  |  |
|  |  |  |  |  | µ/ = | 0,041 | cm2/g |  |  |
|  |  |  |  |  | µ = | 0,46 | cm-1 |  |  |
| 1,5 |  |  |  |  | eµx = | 1,8 | = atténuation |  |  |
| 0,5 |  |  |  |  | H°2 = | 15,2 | µSv/h à 1 m |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  | **1-5/** |  |  | d = | 1,5 | m |  |  |
| 1 |  |  |  |  | H°3 = | 6,8 | µSv/h à 1,5 m |  |  |
| 0,5 |  |  |  |  | zonage = | ZCV |  |  |  |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | |  |  |  |  |
|  | **2/** | **Amélioration de l’éclairage au poste de travail** | | | | | | 6 pts |  |
|  |  |  |  |  | |  |  |  |  |
|  |  | **2-1/** | **Eclairage existant au poste de travail** | | | | |  |  |
|  |  |  |  | |  | nb tubes = | 3 |  |  |
|  |  |  |  | |  | P = | 34 | W |  |
|  |  |  |  | |  | d = | 2 | m |  |
|  |  |  |  | |  |  |  |  |  |
|  |  |  | **2-1-1/** | |  | Eff = | 50 | lm/W |  |
| 1 |  |  |  | |  |  = | 5 100 | lm |  |
|  |  |  |  | |  |  |  |  |  |
| 0,5 |  |  | **2-1-2/** | |  | I = | 406 | cd |  |
| 0,5 |  |  |  | |  | E = | 101 | lx |  |
|  |  |  |  | |  |  |  |  |  |
| 0,5 |  |  | **2-1-3/** | |  | éclairage insuffisant | |  |  |
|  |  |  |  | |  | il faut 200 lx à minima | |  |  |
|  |  |  |  | |  |  |  |  |  |
|  |  | **2-2/** | **Choix d’un nouvel éclairage** | | | | |  |  |
|  |  |  | **2-2-1/** | |  | on veut |  |  |  |
| 0,5 |  |  |  | |  | E > | 200 | lx |  |
|  |  |  |  | |  |  |  |  |  |
| 1 |  |  | **2-2-2/** | |  | I > | 800 | cd |  |
| 1 |  |  |  | |  |  > | 10 053 | lm |  |
|  |  |  |  | |  |  |  |  |  |
|  |  |  | **2-2-3/** | |  | proposition |  |  |  |
|  |  |  |  | |  | P = | 32 | W |  |
|  |  |  |  | |  | Eff = | 114 | lm/W |  |
| 1 |  |  |  | |  |  = | 10 944 | lm |  |
|  |  |  |  | |  |  | OK |  |  |
|  |  |  |  | |  |  |  |  |  |
|  | **3/** | **Moyen de levage** | | | | **6,5 pts** |  |  |  |
|  |  |  |  |  | |  |  |  |  |
|  |  | **3-1/** |  |  | | PU moteur palan = | 1,0 | kW |  |
|  |  |  |  |  | | réducteur = | 72% |  |  |
| 1 |  |  |  |  | | PU palan = | 720 | W |  |
|  |  |  |  |  | |  |  |  |  |
|  |  | **3-2/** |  |  | | nmoteur palan = | 1 440 | tr/min |  |
|  |  |  |  |  | | réduction = | 2 000 |  |  |
| 1 |  |  |  |  | | n = | 0,72 | tr/min |  |
|  |  |  |  |  | |  |  |  |  |
|  |  | **3-3/** |  |  | |  = | 0,075 | rad/s |  |
|  |  |  |  |  | | d = | 10 | cm |  |
|  |  |  |  |  | | R = | 5,0 | cm |  |
| 1 |  |  |  |  | | v = | 0,0038 | m/s |  |
| 0,5 |  |  |  |  | | = | 226 | mm/min |  |
|  |  |  |  |  | |  |  |  |  |
|  |  | **3-4/** |  |  | | CS = | 7 |  |  |
|  |  |  |  |  | | g = | 9,81 | N/kg |  |
|  |  |  |  |  | | F = | 190 986 | N | sans CS |
|  |  |  |  |  | | M = | 19 468 | kg |
|  |  |  |  |  | | F = | 27 284 | N | avec CS = 7 |
| 2 |  |  |  |  | | M = | 2 781 | kg |
|  |  |  |  |  | | (le constructeur avait travaillé avec un coeff de sécu de 5) | | | |
|  |  |  |  |  | |  |  |  |  |
|  |  | **3-5/** |  |  | | vitesse conforme | |  |  |
|  |  |  |  |  | | CS insuffisant | |  |  |
| 1 |  |  |  |  | | processus invalidé | |  |  |
|  |  |  |  |  | |  |  |  |  |
|  | **4/** | **Etude dosimétrique prévisionnelle au poste n°1** | | | | | | **5,5 pts** |  |
|  |  |  |  |  | |  |  |  |  |
|  |  | **4-1/** |  |  | | H°3 = | 6,8 | µSv/h à 1,5 m |  |
|  |  |  |  |  | | T = | 44,5 | jours |  |
|  |  |  |  |  | | t = | 10 | jours |  |
|  |  |  |  |  | | t/T = | 0,22 | période |  |
|  |  |  |  |  | | 2Δt/T = | 1,17 | = atténuation |  |
|  |  |  |  |  | | (A = | 154 | MBq) |  |
| 1,5 |  |  |  |  | | H°4 = | 5,8 µSv/h | à 1,5 m |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **4-2/** | EDP | | |  | | | |  | | | | | | |  |  | | | |  | | | | |  | | | | | |  | | | | |  | | | |
|  |  | Service | | |  | | | |  | | | | | | | Nb. Inter | Durée en h | | | | Cexpo | | | | | H°4 µSv/h | | | | | | Eindiv µSv | | | | | S en H.µSv | | | |
|  |  | ELEC | | | Ctrl AMSR | | | | Hors ZC | | | | | | | 2 | 1 | | | | - | | | | | 0,0 | | | | | | 0,0 | | | | | 0,0 | | | |
|  |  |  | | | Débrochage moteur | | | |  | | | | | | | 2 | 2 | | | | 0,8 | | | | | 5,8 | | | | | | 9,3 | | | | | 18,5 | | | |
|  |  | AUTO | | | Démontage capteurs | | | |  | | | | | | | 2 | 1,5 | | | | 0,9 | | | | | 5,8 | | | | | | 7,8 | | | | | 15,6 | | | |
|  |  | MECA | | | Maintenance pompe | | | |  | | | | | | | 3 | 8 | | | | 0,6 | | | | | 5,8 | | | | | | 27,8 | | | | | 83,3 | | | |
|  |  | AUTO | | | Remontage capteurs | | | |  | | | | | | | 2 | 1,5 | | | | 0,9 | | | | | 5,8 | | | | | | 7,8 | | | | | 15,6 | | | |
|  |  | ELEC | | | Ctrl AMSR | | | | Hors ZC | | | | | | | 2 | 1 | | | | - | | | | | 0,0 | | | | | | 0,0 | | | | | 0,0 | | | |
|  |  |  | | | Rebrochage moteur | | | |  | | | | | | | 2 | 2 | | | | 0,8 | | | | | 5,8 | | | | | | 9,3 | | | | | 18,5 | | | |
|  |  |  | | |  | | | |  | | | | | | |  | 17 | | | |  | | | | |  | | | | | | 61,9 | | | | | 152 | | | |
|  |  | 2 pts | | | H = | | | | H°.t.Cexpo | | | | | | |  |  | | | |  | | | | |  | | | | | |  | | | | |  | | | |
|  |  | 1pt | | |  | | | | E = H.WT | | | | | | | avec | WT = 1 | | | | | | | | | car corps entier | | | | | |  | | | | |  | | | |
|  |  | 1 pt | | |  | | | | S = | | | | | | | individuelle |  | | | |  | | | | |  | | | | | |  | | | | |  | | | |
|  |  | | **5/** | **Situation dégradée lors de la maintenance de la pompe** | | | | | | | | | | | | | | | **11,5 pts** | | | | |  | | | |  | | | | |
|  |  | |  |  |  | | | |  |  | | | |  | | | | |  | | | | |  | | | |  | | | | |
|  |  | |  |  |  | | | |  | t = | | | | 30 | | | | | min | | | | |  | | | |  | | | | |
|  |  | |  |  |  | | | |  | = | | | | 0,5 | | | | | h | | | | |  | | | |  | | | | |
|  |  | |  |  |  | | | |  | AV0 = | | | | 11,5 | | | | | kBq/m3 | | | | |  | | | |  | | | | |
|  |  | |  |  |  | | | |  |  | | | |  | | | | |  | | | | |  | | | |  | | | | |
|  |  | |  | **5-1/** | | | **Evaluation de la dose engagée** | | | | | | | | | | | | | | |  | | | | |  | | | | |  | | | | |
|  |  | |  |  |  | | | | |  | | Q = | | | | 1,2 | | | | | m3/h | | | | |  | | | | |  | | | | |
|  |  | |  |  |  | | | | |  | | h(g) = | | | | 1,1.10-08 | | | | | Sv/Bq | | | | |  | | | | |  | | | | |
|  | 1 | |  |  |  | | | | |  | | Ainh = | | | | 6,9 | | | | | kBq | | | | |  | | | | |  | | | | |
|  | 1 | |  |  |  | | | | |  | | Einh = | | | | 76 | | | | | µSv | | | | |  | | | | |  | | | | |
|  |  | |  |  |  | | | | |  | |  | | | |  | | | | |  | | | | |  | | | | |  | | | | |
|  |  | |  | **5-2/** | | | | **Incidence sur le zonage du local** | | | | | | | | | | | | | |  | | | | |  | | | | |  | | | | |
|  | 1 | |  |  |  | | | | |  | | 1.RCA = | | | | 1,9 | | | | | kBq/m3 | | | | |  | | | | |  | | | | |
|  | 1 | |  |  |  | | | | |  | | n.RCA = | | | | 6,1 | | | | | RCA | | | | |  | | | | |  | | | | |
|  | 0,5 | |  |  |  | | | | |  | | zonage = | | | | ZCJ | | | | |  | | | | |  | | | | |  | | | | |
|  |  | |  |  |  | | | | |  | |  | | | |  | | | | |  | | | | |  | | | | |  | | | | |
|  |  | |  | **5-3/** | | | | **Assainissement du local** | | | | | | | | |  | | | | |  | | | | |  | | | | |  | | | | |
|  |  | |  |  | | |  | |  | QV = | | | | 85 | | | | | m3/h | | | | |  | | | |  | | | | |
|  |  | |  |  | | |  | |  | Vlocal = | | | | 120 | | | | | m3 | | | | |  | | | |  | | | | |
|  |  | |  |  | | |  | |  | R = | | | | 0,71 | | | | | h-1 | | | | |  | | | |  | | | | |
|  |  | |  |  | | |  | |  | H°4 = | | | | 5,8 | | | | | µSv/h | | | | | à 1,5 m | | | |  | | | | |
|  |  | |  |  | | |  | |  | classement en ZCV dès que : | | | | | | | | | | | | | |  | | | |  | | | | |
|  |  | |  |  | | |  | |  | Einh + ext < | | | | 25 | | | | | µSv en 1 h | | | | |  | | | |  | | | | |
|  |  | |  |  | | |  | |  | càd, dès que : | | | | | | | | |  | | | | |  | | | |  | | | | |
|  |  | |  |  | | |  | |  | Einh < | | | | 19,2 | | | | | µSv en 1 h | | | | |  | | | |  | | | | |
|  |  | |  |  | | |  | |  | soit : | | | |  | | | | |  | | | | |  | | | |  | | | | |
|  |  | |  |  | | |  | |  | AV < | | | | 0,77 | | | | | RCA | | | | |  | | | |  | | | | |
|  |  | |  |  | | |  | |  | donc : | | | |  | | | | |  | | | | |  | | | |  | | | | |
|  | 3 | |  |  | | |  | |  | tventil = | | | | 2,9 | | | | | h = | | | | | 2 h 55 min | | | |  | | | | |
|  |  | |  |  | | |  | |  |  | | | |  | | | | |  | | | | |  | | | |  | | | | |
|  |  | |  |  | | |  | |  |  | | | |  | | | | |  | | | | |  | | | |  | | | | |
|  |  | |  | **5-4/** | | | **Analyse des causes pour alimenter le REx** | | | | | | | | | | | |  | | | | |  | | | |  | | | | |
|  |  | |  |  | | | **5-4-1/** | |  | | H°gaz = | | | | 6,5 | | | | | µSv/h à 10 cm | | | | | | | | | |  | | | | |
|  | 1 | |  |  | | |  | |  | | x = | | | | 50 | | | | | mm | | | | |  | | | | |  | | | | |
|  |  | |  |  | | |  | |  | | µ = | | | | 0,86 | | | | | cm-1 | | | | |  | | | | |  | | | | |
|  |  | |  |  | | |  | |  | | eµx = | | | | 73,7 | | | | | = atténuation | | | | | | | | | |  | | | | |
|  |  | |  |  | | |  | |  | |  | | | |  | | | | |  | | | | |  | | | | |  | | | | |
|  | 0,5 | |  |  | | | **5-4-2/** | |  | | H°gaz-écran = | | | | 0,1 | | | | | µSv/h | | | | | à 10 cm | | | | |  | | | | |
|  |  | |  |  | | |  | |  | |  | | | |  | | | | |  | | | | |  | | | | |  | | | | |
|  |  | |  |  | | | **5-4-3/** | |  | | H° = | | | | 7,60. 10-07 | | | | | µSv/h par Bq/m3 | | | | | | | | | |  | | | | |
|  | 1 | |  |  | | |  | |  | | H° = | | | | 8,7 | | | | | nSv/h | | | | |  | | | | |  | | | | |
|  |  | |  |  | | |  | |  | |  | | | |  | | | | |  | | | | |  | | | | |  | | | | |
|  | 0,5 | |  |  | | | **5-4-4/** | |  | | Gaz non détectable (ne constitue pas un point chaud) | | | | | | | | | | | | | | | | | | |  | | | | |
|  | 0,5 | |  |  | | |  | |  | | Evolution du DED ambiant non détectable | | | | | | | | | | | | | | | | | | |  | | | | |
|  | 0,5 | |  |  | | |  | |  | | Parade : prévoir une balise aérosols ou à iode | | | | | | | | | | | | | | | | | | |  | | | | |
|  |  | |  |  | | |  | |  | |  | | | |  | | | | |  | | | | |  | | | | |  | | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | **6/** | | **Avis médical** | | | |  |  | | **2,5 pts** | | |  | | |  | | |  | | |
|  | |  | |  | |  | |  | |  |  | |  | | |  | | |  | | |  | | |
|  | | 0,5 | |  | | **6-1/** | |  | |  | anthropogammamétrie | | | | | ou | | | anthroporadiamétrie | | | | | |
|  | |  | |  | |  | |  | |  |  | |  | | |  | | |  | | |  | | |
|  | |  | |  | | **6-2/** | |  | |  | Aint = | | 6,5 | | | kBq | | |  | | |  | | |
|  | |  | |  | |  | |  | |  | T = | | 8,0 | | | jours | | |  | | |  | | |
|  | |  | |  | |  | |  | |  | Tb = | | 140 | | | jours | | |  | | |  | | |
|  | |  | |  | |  | |  | |  | Te = | | 7,6 | | | jours | | |  | | |  | | |
|  | |  | |  | |  | |  | |  | t = | | 60 | | | jours | | |  | | |  | | |
|  | |  | |  | |  | |  | |  | t/T = | | 7,9 | | | périodes | | |  | | |  | | |
|  | |  | |  | |  | |  | |  | 2Δt/T = | | 244 | | | = atténuation | | | | | |  | | |
|  | | 2 | |  | |  | |  | |  | Aint = | | 26,7 | | | Bq | | | négligeable | | |  | | |
|  | |  | |  | |  | |  | |  |  | |  | | |  | | |  | | |  | | |
|  | |  | | **7/** | | **Requalification fonctionnelle** | | | | | | | | **17,5 pts** | | |  | | |  | | |  | | |
|  | |  | |  | |  | |  | |  |  | |  | | |  | | |  | | |  | | |
|  | |  | |  | | **7-1/** | | **Contrôle du débit** | | | | | |  | | |  | | |  | | |  | | |
|  | |  | |  | |  | |  | |  |  | |  | | |  | | |  | | |  | | |
|  | |  | |  | |  | |  | |  | τ = | | 266,63 | | | µs | | |  | | |  | | |
|  | |  | |  | |  | |  | |  | d = | | 20,00 | | | cm | | |  | | |  | | |
|  | |  | |  | |  | |  | |  |  = | | 30 | | | ° | | |  | | |  | | |
|  | | 1 | |  | |  | |  | |  |  | | 0,524 | | | rad | | |  | | |  | | |
|  | |  | |  | |  | |  | |  | c = | | 1 500 | | | m/s | | |  | | |  | | |
|  | |  | |  | |  | |  | |  |  | |  | | |  | | |  | | |  | | |
|  | |  | |  | |  | | **7-1-1** | |  | L = | | 40,00 | | | cm | | |  | | |  | | |
|  | | 1,5 | |  | |  | |  | |  | v = | | 0,2382 | | | m/s | | |  | | |  | | |
|  | |  | |  | |  | |  | |  |  | |  | | |  | | |  | | |  | | |
|  | | 1 | |  | |  | | **7-1-2/** | |  | S = | | 0,03142 | | | m2 | | |  | | |  | | |
|  | | 1 | |  | |  | |  | |  | QVD = | | 26,94 | | | m3/h | | |  | | |  | | |
|  | |  | |  | |  | |  | |  |  | |  | | |  | | |  | | |  | | |
|  | |  | |  | |  | | **7-1-3/** | |  | U = | | 6,6 | | | kV | | |  | | |  | | |
|  | |  | |  | |  | |  | |  | IN = | | 74 | | | A | | |  | | |  | | |
|  | |  | |  | |  | |  | |  | cos  = | | 0,91 | | |  | | |  | | |  | | |
|  | | 1 | |  | |  | |  | |  | PAN = | | 770 | | | kW | | |  | | |  | | |
|  | |  | |  | |  | |  | |  | PUN = | | 710 | | | kW | | |  | | |  | | |
|  | | 1 | |  | |  | |  | |  |  = | | 92,2% | | |  | | |  | | |  | | |
|  | |  | |  | |  | |  | |  |  | |  | | |  | | |  | | |  | | |
|  | |  | |  | |  | | **7-1-4/** | |  | I = | | 70 | | | A | | |  | | |  | | |
|  | | 1 | |  | |  | |  | |  | PA = | | 728 | | | kW | | |  | | |  | | |
|  | | 1 | |  | |  | |  | |  | PU = | | 672 | | | kW | | |  | | |  | | |
|  | |  | |  | |  | |  | |  |  | |  | | |  | | |  | | |  | | |
|  | |  | |  | |  | | **7-1-5/** | |  | QV = | | 1,16E-05 | | | PU | | |  | | |  | | |
|  | | 1 | |  | |  | |  | |  | QV = | | 0,00779 | | | m3/s | | |  | | |  | | |
|  | |  | |  | |  | |  | |  |  | | 28,0 | | | m3/h | | |  | | |  | | |
|  | |  | |  | |  | |  | |  | QVD = | | 26,9 | | | m3/h | | |  | | |  | | |
|  | | 1 | |  | |  | |  | |  | QV/QV | | =4,3% | | | < 5% | | |  | | |  | | |
|  | |  | |  | |  | |  | |  | étalonnage validé | | | | |  | | |  | | |  | | |
|  | |  | |  | | **7-2/** | | **Contrôle de la pression** | | | | | |  | | |  | | |  | | |
|  | |  | |  | |  | |  |  | |  | | |  | | |  | | |  | | |
|  | | 1 | |  | |  | | **7-2-1/** |  | | I = | | | U0/R | | |  | | |  | | |
|  | |  | |  | |  | |  |  | |  | | |  | | |  | | |  | | |
|  | | 1 | |  | |  | | **7-2-2/** |  | | U = | | | x.R.I | | |  | | |  | | |
|  | |  | |  | |  | |  |  | |  | | |  | | |  | | |  | | |
|  | | 1 | |  | |  | | **7-2-3/** |  | | U = | | | x.U0 | | |  | | |  | | |
|  | |  | |  | |  | |  |  | |  | | |  | | |  | | |  | | |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | **7-2-4/** |  | U0 = | 24,0 | V |  |
|  |  |  |  |  |  | p en bar | 100 | 200 |  |
|  |  |  |  |  |  | x | 1 | 0 |  |
|  | 1 |  |  |  |  | U en V | 24,0 | 0 |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  | |  | | --- | | U en V | |  |  |  |  |
|  |  |  |  |  | 24 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  | 1 |  |  |  | 0 |  |  |  |  |
|  |  |  |  |  |  | 100 |  | 200 | p en bar |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  | **7-2-5/** |  |  |  |  |  |
|  |  |  |  |  |  | p = | 177 | bar |  |
|  |  |  |  |  |  | pMax - p = | 23 | bar | ou détermination graphique |
|  |  |  |  |  |  | pMax - pmin = | 100 | bar |  |
|  | 1,5 |  |  |  |  | U = | 5,52 | V |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  | **7-2-6/** |  | Umesurée = | 5,50 | V |  |
|  |  |  |  |  |  | p = | 177,1 | bar |  |
|  | 0,5 |  |  |  |  | étalonnage validé | |  |  |