

מועצה מקומית כפר תבור

מכרז מס' _____

**הרחבה ושדרוג של מט"ש כפר תבור
בשיטת תכנון ביצוע, כולל תפעול ותחזוקה**

**ציוד אלקטרו מכני – המשך חוברת א'
פרק 411**

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להלן טבלה המפרטת את יצרני הציוד המאושרים להשתתף במכרז.

יצרן מאושר	סוג הציוד
MEVA HUBER F.S.M. KUHN	מגוב מכני גס
MEVA, HUBER, P F.S.M. KUHN	מערכת משולבת טיפול קדם
MEVA, HUBER, F.S.M. KUHN	מסנן עדין 1 מ"מ
SSI, INVENT, SANITAIRE, WTE, EDI	מערכת פיזור אוויר
GRUNDFOS, FLYGT, LANDIA, ABS, KSB, INVENT	מערבלים
GRUNDFOS, FLYGT, ABS, KSB, HOMA	משאבות
ABB, HACH, E&H	מכשור
אודיס. עמיעד	סינון לחץ
ALFA LAVAL, EMO, HUBER, ANDRITZ	מסמך בוצה
ANDRITZ, WESTFALIA , ALFA LAVAL, FLOWTWEG	סחיטת בוצה
KUBOTA, ALFA LAVAL, SUEZ (GE)	ממברנות
AERZEN, ATLAS COPCO, ROBUSCHI	מפוחים

411.2 - General Information Regarding the Supply of Equipment

The following are some general details and conditions that the suppliers and manufacturers of equipment for this project shall pay attention to and consider when selecting the equipment they offer to supply:

Representation in Israel :

- Offers should include only equipment from manufacturers who are represented in Israel by a technical representative.

Safety :

- All equipment should be designed for safe operation and maintenance.

Lubrication :

- All lubrication points, such as grease nipples, oil replacement, etc., shall be in a location that allows easy and safe access.
- Oil filling plugs shall be placed at the highest point of the unit.
- Oil draining plugs shall be placed at the lowest possible point of the housings.
- Suitable means of determining oil levels, either by a dipstick or by oil level window, are to be easily accessible for measuring / reading.
- Oil level indicators shall be located in free and observable locations.
- Oil removal valves or plugs shall be located such that no oil will leak into the water that is being treated.

Materials of Construction (MOC) and Corrosion Protection :

- Manufacture shall offer MOC and coatings that, based on their experience, provides the best results for 15 years of operation, in a

wastewater treatment plant (WWTP) operating under climatic and wastes conditions, similar to Earon WWTP.

Protective Coatings :

- All carbon steel surfaces shall be coated, except for stainless steel and galvanized surfaces.
- All welds shall be cleaned before galvanizing or coating. No field welds are allowed.
- Galvanized surfaces shall be hot coated galvanized. Manufacturer shall submit standards for the galvanization process.
- All coatings shall be completely shop-applied and not field-applied.

Fastening Materials :

- Thread type : Imperial
- Steel structures : Bolts, nuts, and washers : A4, AISI 316 stainless steel
- Stainless steel structures : Bolts, nuts, and washers : AISI 316 stainless steel.
- Anchor bolts and anchor rails: Dimensions: Minimum M16 (mm)
- Material: Stainless steel, AISI 316 stainless steel
- Cables: 316 stainless steel

Gears :

- See specifications and manufacturers of gears, in the relevant chapters.

Bearings :

- Bearings manufactured by SKF are preferable.
- All bearings shall be anti-friction ball- or roller-type, designed for a B-10 lifetime of at least 100,000 hours.

Motors :

- The motors shall be 3-phase, 400/230 V, 50 Hz, as per the required rpm.
- All motors shall have a 1.15 service factor.
- Motors will in general be suitable for operation through a frequency converter, with a control of 4–20 mA signals.

Electric and Control Cables :

- All the electrical and control cables shall be routed inside protective piping, so as to protect them against mechanical and environmental damage. Yet all cables should be coated and protected, so as to enable their long time operation, while immersed in water.

Motor Speed Variators (Frequency converters) :

- Only electronic frequency converters will be considered.
- Mechanical variators are not acceptable.

Maintenance :

- All equipment shall be designed so as to allow easy and safe access for inspection and maintenance.

Lifting Devices :

- All equipment that operates underwater, or in a deep or otherwise difficult place to access for inspection or maintenance, shall be supplied with lifting "ears", that will enable it to be lifted to ground level and placed on the pavement for service.

The lifting device shall be high enough to allow it to place the lifted equipment on top of a truck.

One lifting device may serve more than one piece of equipment, such as one lift for two pumps, etc.

Spare Parts :

All equipment shall be offered with a separate list of spare parts for two years of operations. In addition, the manufacturer shall ensure additional supply of spare parts for at least five more years of operation.

Automatic & manual operation :

The plant is designed to be operated in a fully automatic manner. However, all the electrical equipment, such as pumps, valves, drive mechanism etc., shall have a manual override over the control system for routine maintenance and for emergency situations.

Scope of Supply :

- The following technical specifications, provide description of the required equipment, but do not cover all details, which will be suited by the supplier, to the specific use of the exact requirements of the equipment which is offered.
The specifications, do however cover the supply, installation, field testing and calibration of all the offered equipment.
- Any additional equipment, necessary for the proper operation of the proposed installation, not specifically mentioned in these specifications shall be furnished and installed, as part the main offer and at no additional cost to the Client.
- It is emphasized that a warranty period of 24 months after commissioning of the plant is required for all the equipment.
- A period of 3 years after the warranty period completion is required to supply all spare parts.

411.3 - Pretreatment System :

411.3.1 - General :

This chapter covers the supply, of a pretreatment system.

All equipment supplied under this part shall be supplied by one manufacturer only.

All of the above equipment shall be included in the proposal, along with all other items necessary to form a complete and efficient system for adequate operation and maintenance, such as the following :

- Structural steel and other materials
- Motors, gears, etc.
- Electrical and control boxes, electrical panels, controllers (PLC), cables, etc.
- Limit switches
- Platforms, supports, ladders, handrails, knee rails, etc.
- Pumps
- Scum blades
- Piping, valves, accessories, etc.
- Fasteners, anchors, clamps, etc.

411.3.2 מגוב מכאני גס (מרווח סינון 6-10 מ"מ)

נתונים כלליים

הקבלן יספק וייתקין יחידה מושלמת של מגוב מכאני בניקוי קדמי (2 יחידות מגוב). ההתקנה תתבצע במבנה המגוב, דרך פתח בגג לאחר סיום הבניה. בזמן הבניה יבצע קבלן הנדסה אזרחית את ההכנות הדרושות בבטונים עבור מסילות המגוב בהתאם להנחיית היצרן.

המגוב יהיה משופע בניקוי קדמי ויוותקנו בתוך תעלה בזווית של 80 מעלות.

כל חלקי המגוב יהיו מתוכננים לשרת במאמצים ובתנאים העשויים להיווצר במהלך פעולת הציוד.

סוג הנוזל יהיה ביוב עירוני גולמי הכולל מגבונים, תחבושות וכד', ללא שיקוע חול לפני המגוב.

תאור המגוב

המגוב כולל רשת מוטות (BAR SCREEN) המותקנת בתחתית התעלה כאשר תחתית המוטות מעוגלת (צורת J) למניעת שטחים מתים, הגורמת ללכידת המוצקים ברשת המוטות ועקב כך לעלית המפלס במעלה הזרם. עלית מפלס הנוזל מזוהה ע"י רגש מפלס מסוג Ultrasonic W.L דיפרנציאלי וגיבוי בטיימר (כאשר מרווחי הפעולה נקבע ע"י המפעיל) שמפעיל את המנוע המניע שתי שרשראות אין סופיות שאליהן מחוברות מגרפות, המרחק בין המגרפות יהיה 2.0 מ' לכל היותר, עוקבות הנכנסות לרשת המוטות ומפנות את הגבבה הלכודה מחלקה התחתון של הרשת עד לנקודת ניקוי המגרפה באמצעות להב (ניקוי באמצעות מברשות ומערכת מתזים לא תאושר) ללא צורך בשטיפה המפילה את הגבבה למסוע חלוני.

צורת המוטות תהיה באחת משתי החלופות : מוטות בחתך מלבני, מוטות בחתך הידרודינאמי (צורת דמעה).

במגוב בעל מוטות בחתך מלבני לא תתאפשר מהירות זרימה מקסימאלית מעל 1.0 מ' לשנייה במגוב בספיקת שיא במים נקיים.

במגוב בעל מוטות בחתך הידרודינאמי לא תתאפשר מהירות זרימה מקסימאלית מעל 1.4 מ' לשנייה במגוב בספיקת שיא במים נקיים.

על היצרן לספק חישובים הידראוליים לגובה נוזל ומהירויות זרימה בכניסה למגוב, במגוב וביציאה לספיקת שיא ממוצעת מינימאלית.

המתקן הינו מתקן אוטומטי לחלוטין עשוי כולו פלבי"מ 316L ובכלל זה מבנה המגוף הכולל מסגרת מסיבית העמידה לכוחות הנוצרים תוך כדי עבודת המגוב ולאורך זמן, רשת סינון מוטות בתחתית, משטח הובלה עד למשפך, שתי שרשרות אין סופיות ומנגנון גריפת גבבה בראש המגוב.

המתקן כולל מערכת מושלמת של פיקוד ובקרה הכולל מפסק קפיצי, בקר מתוכנת וכל הדרוש להתקנה מושלמת והפעלה של המתקן.

המגוב יסופק עם מנגנון אלקטרו מכני דרוך קפיץ המשמש להגנת עומס יתר על הגורפים ומונע ע"י כך נזק למערכת הגורפים.

במצב עומס יתר יתריע מנגנון עומס יתר לבקר ויגרום לכיוון תנועה הפוכה של המגרפות לפרק זמן שיקבע ע"י הספק עד לשחרור המגרפה והפיכת כיוון הסיבוב פעם נוספת להסרת הגורם לעומס.

פעולה זו תתבצע שלוש פעמים, במידה ופעולות אלו לא יגרמו לשחרור הגורם לעומס תישלח הודעת תקלה למערכת הודעת התקלות של המפעיל.

חומרי מבנה ופרטים טכניים

כל חלקי המגוב יהיו עשויים פלבי"מ 316L כולל השרשרת, גלגלי (רולרים) השרשרת ומסבים וגלגלי שיניים עיליים ותחתיים (לא יאושר מגוב הכולל שרשרת מחומרי מבנה שונים).

המסבים התחתונים יהיו עם בית מיסב מפלבי"מ, ציר יציקת פלדה ותותב

מ- SILICIUM-carbide לעמידות מירבית בשחיקה ולאורך חיים מקסימאלי.

המסב התחתון קראמי ואינו דורש טיפול.

לא יתקבל מסנן ללא מסבים תחתונים.

לאורך כל המגוב יותקנו מכסים מחומרי מבנה פלבי"מ 316 למניעת נפילת הגבבה ובטיחות המפעיל, המכסים יהיו ניתנים להסרה בקלות באמצעות אומים מפלבי"מ 316.

גבבת המגוב תישפך למע' דחסן ומסועים ולמכולה, כמוראה בשרטוט המצורף.

טיפולם הנדרשים לצורך תחזוקת המגוב כגון גירוז ושימון יבוצעו בחלקו העליון של המגוב מעל רצפת התפעול ללא צורך בירידה לתעלות השפכים.

עבור החלפת מיסב תחתון, ו/או בדיקת מתיחת שרשרת יהיה צורך בירידה אל תחתית התעלה.

מערכת ההנעה הינה ע"י מנוע גיר המסופקת ע"י היצרן, המנוע יהיה תוצרת חב' BAUER או NORD או שווה ערך במבנה BEVEL, 3 פאזות, 50 הרץ, 400 וולט, רמת אטימות IP 65. כל המערכת תהיה מוגנת פיצוץ ברמת DIV 2 CLASS 1.

כח הקריעה של השרשרת לא יופחת מ- 112KN.

המסרקים (COMB) ניתנים יהיו לפירוק מגוף המגוב (RAKE) באמצעות ברגים ולא יהיו חלק ממנו.

הגורף הנגדי לניקוי המסרקים יהיה ניתן להחלפה ולא יהיה חלק מגוף המנגנון.

המגוב יסופק עם מנגנון הקפיץ יהיה בין גוף הממסרה (גיר) וגוף המגוב והוא מתארך כפונקציה של מומנט הממסרה וכך חש במומנט גבוה, או מנגנון חשמלי המשמש להגנת עומס יתר.

יש לספק עם המגוב גשש למיקום הגורף אשר באמצעותו לא ניתן יהיה לעצור את פעולת המגוב כאשר גורף נמצא טבול במים.

לוח חשמל

לוח החשמל המסופק ע"י ספק המגוב (לוח עבור כל מגוב בנפרד) יהיה מחומרי מבנה פוליאסטר משוריין ברמת אטימות IP65, לוח החשמל יותקן באיזור שדורש מוגן התפוצצות ובאיזור קורוזיבי בתוך מבנה המגוב. לוח החשמל ייוצר בארץ באמצעות יצרן לוחות מוכר שייצר לוחות מסוג זה בעבר. הלוח עצמו ייוצר לפי תקן 61439 רמת מידור 2B. מערכת הפיקוד תענה לכל דרישות היצרן ולתפ"מ של היצרן והספק מתחייב לכך, ויאושר ע"י המזמין.

כל לוח יכלול את הרכיבים הבאים:

מפסק ראשי.

ספק מתח.

בקר מתוכנת להפעלת המערכת ותוכנת ממשק עם חיווי תקלות.

בקר גובה Ultrasonic W.L המותקן בתעלת המגוב.

מגעים יבשים להעברת התקלות ללוח הבקרה הראשי.

תכולת העבודה ללוח החשמל:

העבודה כוללת חיווט בין כל האלמנטים כולל כבלים בחתך מתאים בצינורות מגן או בתעלות כולל איטום כניסות, סימון כבלים.

הספק יגיש לאישור את פירוטי הלוח סכימות חד קווית, ותפ"מ (לא יאושר לוח שלא יסופק ע"י ספק המגוב).

פרוטוקול התקשורת יקבע באמצעות MOD BASS או PROFI BASS.

יסופק בורר קפיצי להפעלה קדימה ואחורה של המגוב שיותקן בקופסה נפרדת סמוך למגוב.

תפעול המגוב

הפעלת המגוב תיעשה עפ"י תפ"מ היצרן.

תחילת הפעלת המגוב תבוצע עפ"י מדידת שינוי במפלסי השפכים במורד המגוב ובמעלה המגוב, או לחילופין עפ"י הפרש זמן מההפעלה האחרונה הראשון מביניהם, כמו כן הפנל המקומי יאפשר הפעלת המגוב ביוזמת המפעיל.

במידה והפעלת המגוב לא תגרום לירידת מפלס המים במעלה המגוב, המגוב יעבור לפעולה רציפה ו/או להגברת מהירות, הכל לפי תפ"מ היצרן.

במקרה בו המגוב "יתקע" כתוצאה מגוף זר, תזוהה עליה בצריכת הזרם של המנוע שיופעל אוטומטית, היפוך תנועה של המגרפות לפינוי הגוף הזר.

תוכנת המגוב תאפשר 3 נסיונות בשיטה זו ורק לאחר מכן יוציא הודעת תקלה, הכל לפי תפ"מ היצרן שיצורף להצעה.

היקף אספקה והתקנה

האספקה של המגוב המכאני תהייה לאתר המט"ש.

התשלום עבור המגוב ישולם לפי יחידות מסווג לפי רוחב התעלה וספיקת המגוב. המחיר יכלול את המגוב כקומפלט, כמפורט במפרט הטכני והמחיר יכלול גם את לוחות החשמל והפיקוד, כל החומרים והאביזרים הנלווים הנדרשים להתקנה מושלמת של המגוב, כולל כל הנדרש עבור בדיקות ההרכבה של המגוב הרצה וכד'.

411.3.4 מסוע בורגי

הקבלן יספק מסועים בורגיים. מטרת המסועים הינה הובלת המוצקים המסולקים – (הגבבה) אל המכולה, וחלוקת הגבבה במכולה.

מסוע אופקי ו/או אנכי יכול את כל המרכיבים והציוד הדרושים, כולל: חלזון, המנוע, הגיר להקטנת מהירות, התמסורת למסוע, קונסטרוקציית התמיכה במסוע, מגינים למנוע ולתמסורת, צנרת שתותקן בתחתית המסוע לאיסוף הנוזלים, הבקרה וכו'.

כושר הובלת המוצקים המסוננים ע"י המסוע הבורגי, לא יפחת מ- 2,000 ליטר שעה, (2 טון/שעה), שהוא יוכל להוביל את כל כמות הגבבה המסולקת מהשפכים ע"י המגוב, גם בשלב העתידי, כאשר שלושה מגובים יהיו בפעולה ביחד. קוטר המסוע לא יפחת מ- 320 מ"מ.

בנוסף, המסוע יכיל מכסה אשר יכסה את המסוע לכל אורכו, משפך לכניסת המוצקים אליו, מנוע עם גיר, תמסורת לציר, מובל להוצאת החומר הדחוס מראש המסוע, מגינים עבור המנוע והתמסורת, אביזרי בטיחות, קונסטרוקציית התמיכה במסוע, בקרת פעולת המסוע וכו'.

המים המסולקים מהמוצקים המסוננים, תוך כדי הובלתם ע"י המסוע ותוך כדי פעולת הדחיסה, יאספו דרך צינור פלסטי גמיש, בעל קוטר של 80 מ"מ. המים יסולקו למערכת ניקוז, אשר תותקן על הרצפה בסמוך למסוע, ע"י הקבלן.

במידת הצורך גירוז המיסבים יבוצע באמצעות צינורות גירוז מוארכים אשר יחוברו לפיטמות הגירוז ואשר קצותיהם נמצאים מעל המכסה, כך שפעולת הגירוז תבוצע ללא צורך בפירוק המכסה.

מכסה המסוע יתוכנן ויותקן כך, שלא תהיה כל הפרעה להולכת הגבבה המסולקת מהשפכים. כמו כן, המכסה יהיה קל לפירוק מהמסוע ולהרכבתו מחדש, על מנת לאפשר בדיקה ותחזוקה קלה למערכות המסוע.

החלקים השונים של המסוע, האביזרים השונים, המכסה, המשפך לכניסת המוצקים, המובל להוצאת החומר הדחוס מראש המסוע וכו' יהיו בנויים מפל"ב מ 316 לפחות.

החלזון יהיה עשוי פלדה פחמנית מוקשחת כגון S355JO.

כל החלקים והאביזרים, המחברים בין המגוב למסוע, כגון צנרת, אביזרי צנרת, מגופים, תמיכות למיניהן וכו', יסופקו ע"י הקבלן.

המסוע יפוקד ע"י לוח פיקוד עצמאי אשר יעבוד בחיגור עם לוחות המגובים ויפעיל את כל המסועים והדחסן עפ"י תפ"מ שיוכן ע"י ספק הציוד שיהיה אחראי לפעולת כל המערכות.

411.3.5 דחסן גבבה

הקבלן יספק מערכת של דחסן לגבבה, המסולקת ממי השפכים באמצעות המגוב. הדחסן יבצע: ניקוי, שטיפת הגבבה, שטיפת חורים וניקוז נוזל הגבבה, סילוק מירבי של המים, דחיסת הגבבה והובלתה.

הדחסן יהיה מצויד בבורג ארכימדס בעל ציר ובעל כריכה אחת.

קצה הכריכה יהיה מצופה ברצועה העשויה פלדה מוקשית כגון EN-8 על מנת להקטין את שחיקת הבורג.

כמו כן, תותקן בקצה הכריכה מברשת מיוחדת לניקוי השוקת של הבורג. המברשת תותקן כך, שתהיה קלה להרכבה ולפירוק, על מנת להקל על התחזוקה. הבורג יותקן בתוך שוקת, בעלת חתך חצי מעגלי. השוקת תכיל חורים לניקוז הנוזל הממוצה מתוך הגבבה.

הדחסן יופעל באמצעות מנוע גיר המסופק ע"י יצרן הדחסן, המנוע יהיה תוצרת חבי' BAUER או NORD או שווה ערך במבנה BEVEL, 3 פאזות, 50 הרץ, 400 וולט, רמת אטימות IP 65. כל המערכת תהיה מוגנת פיצוץ ברמת 1 DIV 2 CLASS.

הדחסן יצויד במשפך כניסה, אשר דרכו תוכנס אליו כל הגבבה מהמגובים.

הגבבה תובל בקטע הבסיס, קטע בו היא תנוקה ויסולקו ממנה עודפי מים. מקטע זה, הגבבה מובלת אל תא הדחיסה. בתא הדחיסה, תועבר הגבבה באמצעות הבורג ותשטף, הגבבה השטופה והדחוסה תוצא דרך מובל מיוחד, אל נקודת הסילוק.

המים המסולקים מהמוצקים המסוננים, הן בקטע הבסיס והן תוך כדי פעולת הדחיסה, יאספו בשוקת ויסולקו מתחתיתה, דרך צינור פלסטי גמיש, בעל קוטר של 100 מ"מ. המים יסולקו למערכת ניקוז, אשר תותקן על הרצפה בסמוך למסוע, ע"י הקבלן לעבודות אזוריות.

מערכת הדחסן, תתוכנן לטיפול בכל הגבבה המסולקת מהשפכים ע"י מערכת המגובים, לדחיסתה לדרגת יובש של לפחות 35% מוצקים.

כושר דחיסת הגבבה יהיה כזה, שהוא יוכל לטפל בכל כמות הגבבה המסולקת מהשפכים ע"י המגובים, גם בשלב העתידי, כאשר שלושה מגובים יהיו בפעולה ביחד, ובסה"כ 4 טון/שעה.

במערכת המנוע-גיר, תותקן הגנת זרם גבוה, אשר תעצור את המנוע, על מנת למנוע הפעלת מומנט גבוה על הציר.

החלקים השונים של הדחסן, כגון הציר המרכזי, האביזרים השונים, השוקת לאיסוף הנוזלים, המכסה, המשפך לכניסת המוצקים, המובל להוצאת החומר הדחוס מראש הדחסן וכו' יהיו בנויים מפלב"מ 316 לפחות.

הספק המספק את מערכת הדחסן, יספק מערכת שטיפה כפולה: לגבבה ולרשת הסינון. המערכת תתבסס על צנרת בקוטר של 1.5" ותכיל מערכות שטיפה והתזה, כולל כל הצנרת, האביזרים ומגופים רגילים וסולנואידים.

הדחסן יפוקד ע"י לוח הפיקוד של המסועים. הדחסן יפעל עפ"י תפ"מ היצרן שיסופק עם ההצעה.

411.3.6 מלכודת גרוסת

א. כללי

מלכודת גרוסת תהיה עגולה עם כניסה משיקית ויציאה מרכזית מסוג STIRRED VORTEX GRIT TANKS. מהלך השפכים בין הכניסה והיציאה מהמיכל לא יהיה פחות מ- 270 מעלות בהיקף המיכל.

מפרידי הגרוסת יופעלו עפ"י העקרון הצנטריפוגלי עיקרון ה- VORTEX.

המערכת תהיה מתוצרת JONES & ATTWOOD או שווה ערך ואיכות.

הציוד המסופק יותקן בתוך מבנה בטון עגול אשר ייבנה לפי שרטוט יצרן ובמידות לפי הספיקה השעתית המחושבת ע"י הקבלן.

המערכת המסופקת תפריד לא פחות מ- 95% מהגרוסת בגודל מעל 0.25 מ"מ ו- 65% מהגרוסת מעל 0.15 מ"מ בעלת משקל סגולי של 2.65 גר"סמ"ק.

תרחיף הגרוסת ששקע יוזרם באמצעות משאבה לממיין חול אשר יסמיך את הגבבה ויסיע אותה אל מכולה לסילוק. תשטיפים משוטף החול יוחזרו אל תחנת השאיבה.

הקבלן יספק 2 יחידות הפרדה הכוללות:

- יחידת "וורטקס".
- יחידת הנעה.
- משאבת תרחיף.
- לוח חשמל ובקרה. (משותף לשתי היחידות).

ג. יחידת ה"וורטקס"

בחלקו התחתון של המיכל העליון יותקן מתקן "וורטקס", אשר יקנה לנוזל הנכנס תנועה סיבובית, אשר תהיה בכיוון הזרימה. המתקן יקנה לנוזל מהירות סיבוב, לא פחות מ- 3.0 מטר לשנייה.

המתקן יורכב משלושה חלקים עיקריים:

- האימפלר.
- ציר הנעה (כולל יחידת הנעה).
- המנוע.

האימפלר

יכול ארבע כנפיים, כאשר כל שתיים מרותכות על קשת שהיא חצי עיגון. שתי הקשתות תורכבנה על הציר באמצעות ברגים. ההרכבה תאפשר התקנה של הכנפיים בגובה משתנה, על מנת להשיג יעילות הפרדה מכסימאלית של הגרוסת. קוטר עיגול הכנפיים יהיה כ- 75-70 אחוזים מהקוטר הפנימי של המיכל העליון. זווית הכנפיים כלפי האנך תהיה 30 מעלות, על מנת להקנות לנוזל גם רכיב אנכי, כלפי מעלה. דבר זה הינו בעל חשיבות, על מנת למנוע שיקוע של המרכיבים הגדולים והקלים בביוב ולכוונס ליציאה מהמפריד, ביחד עם זרם הביוב. מהירות הסיבוב תהיה עד כ- 15 סל"ד. הקצה התחתון של האימפלר, יהיה כ- 100-50 מ"מ מעל המיכל התחתון, ניתן כאמור לכיוון.

חומרי המבנה

כל המערכות הטבולות של המערבל, תהיינה בנויות מפלב"מ 316. הנ"ל כולל את כל הברגים והאומים. החיבור בין אוגן המערבל לאוגן הגיר, יבוצע כך שלא תיווצר קורוזיה.

ציר ההנעה

ציר ההנעה יהיה צינור בקוטר לא פחות מ- 6", אשר על קצהו התחתון יורכב האימפלר וקצהו העליון יהיה מחובר ליחידת ההנעה.

יחידת ההנעה

יחידת ההנעה תורכב מהמנוע ומהגיר מקטין המהירות.

המנוע

- מנוע תלת פאזי, בעל הנתונים הבאים:
- הספק – לא פחות מ- 0.55 קווא"ט.
- מתח – 400 וולט.
- תדירות מירבית – 50 הרץ.
- מקדם שירות – 100%.

- מהירות סיבוב – 1,500 סל"ב"ד.
- מותאם להתקנה חיצונית.
- בעל קירור אוויר.

הגיר

- גיר ספיראלי – Helical Gear, בעל הנתונים הבאים :
- הגיר והמנוע יהיו מחוברים יחד, כאשר ציר היציאה של המנוע הינו ציר הכניסה של הגיר.
 - מותאם להעברת הספק גדול פי חמש מהספק המנוע.
 - יחס הקטנת המהירות – כ- 100.
 - מותאם להתקנה חיצונית.
 - בעל מבנה אטום לחלוטין.
 - מכיל אמבט שמן פנימי.
 - מתוכנן ל- 100,000 שעות עבודה.
 - מתוכנן לעבודה רציפה של 24/7.

ג. משאבת תרחיף הגרוסת ששקעה

- הגרוסת ששקעה תסולק מתחתית התא התחתון באמצעות משאבה צנטריפוגלית (טבולה בהתקנה יבשה), אשר תוצב בתא יבש לצד התא התחתון.
לכל אחת משתי המערכות תסופק משאבה אחת. (סה"כ יסופקו שתי משאבות).
מפלס המשאבה יהיה נמוך, כך שהיא תהיה תמיד מטובעת.
המשאבה תסלק את התרחיף לשוטף החול.

המשאבה הינה בעלת הנתונים הבאים :

- ספיקת המשאבה – יחושב ע"י הקבלן ויאושר ע"י המזמין/
- לחץ העבודה – יחושב ע"י הקבלן ויאושר ע"י המזמין.
- מעבר חופשי – 80 מ"מ
- מהירות הסיבוב – 1,500 סל"ב"ד

המנוע

מנוע תלת פאזי, בעל הנתונים הבאים :

- מתח – 400 וולט
- תדירות מירבית – 50 הרץ
- מקדם שירות – 100%
- מהירות סיבוב – 1,500 סל"ב"ד
- מותאם להתקנה חיצונית.
- בעל קירור אוויר (באמצעות מעטפת קירור).

ד. צורת הפעלת המערכת

- המפרידים עצמם, כולל המערכת הסובבת שלהם, פועלים ללא הפסקה.
תדירות הפעלת משאבות תרחיף הגרוסת, תיקבע ע"י המפעילים על פי הנסיון המצטבר שלהם, לעונות השונות של השנה ולתנאי הביוב הנכנס.
בכל מקרה, רצוי שהפעלת המשאבות תהיה אחת אחרי השניה ולא שתיהן ביחד.

ה. לוח החשמל והבקרה

- לוח החשמל והבקרה, יפעיל את כל מערכת מפרידי הגרוסת, כולל המפרידים עצמם, והמשאבות.

ההפעלה תתאפשר בשתי צורות :

- הפעלה אוטומטית, אשר תהיה ההפעלה השגרתית של המערכת.
- הפעלה ידנית, המיועדת לביצוע בדיקות, תחזוקה וכו'.

הלוח יכיל את כל המתנעים וההגנות למנועים, את משני התדר עבור המערבלים והמשאבות וכן בקר מתוכנת PLC, אשר באמצעותו יתוכננו כל הפעולות, הזמנים, משכי הפעולה וכו'.

הלוח יכיל את כל כרטיסי ה-I/O וכן את הקשר לבקר הראשי של המט"ש.

הלוח יכיל על הדלת החיצונית צג הבקר אשר יתאר את המצב הרגעי של מערכת ההפרדה כולה וכן תאפשר שינוי של נתוני ההפעלה.
הלוח יתוכנן להתקנה חיצונית, מתחת לגגון.

ו. מבחן יעילות מערכת הפרדת הגרוסת

על מערכת הפרדת הגרוסת, להפריד מהשפכים את הגרגרים שגודלם 0.25 מ"מ ומעלה ובעלי משקל סגולי של כ- 2.5, ביעילות של 95% וגרגרים שגודלם מעל 0.15 מ"מ, ביעילות של 65%.

על מנת להציג את הביצועים של המערכת כולה של הפרדת הגרוסת מהשפכים המסוננים ולהוכיח שהמערכת שסופקה פועלת ביעילות ועונה על דרישות המכרז, ספק המערכת יבצע בדיקות מעשיות בשטח, כחלק ממחויבותו החוזית.
ביצוע הבדיקות, כולל כל הציוד הדרוש לכך וכן עלות האנליזות, הינם חלק מאספקת הציוד ולא ישולם בגין זאת תשלום נוסף.

- לאחר הפעלת המערכת כולה, תילקחנה עשר דגימות לפחות מהשפכים הנכנסים למערכת ההפרדה, ובמקביל מהשפכים היוצאים מכל אחד משני המפרידים.
- הדגימות תישלחנה למעבדה מוסמכת, אשר בה ייבדקו ריכוזי המקטעים השונים לכל טווח קטרים ותחושב יעילות הסילוק.
- אם ימצא שהיעילות נמוכה מהדרוש, יבצע הספק על חשבונו שינויים בפרמטרי התפעול ו/או כל שינוי אחר, כולל שינויים חשמליים / מכניים, על מנת להגיע ליעילות הסילוק הנדרשת, כולל ביצוע מחדש של הבדיקות.

411.3.7 - Combined units of fine screening, grit and scum removal systems: (מכונה משולבת לסינון, הרחקת חול ושומנים)

General

Four combined pre-treatment units shall be provided, to be installed Downstream of the incoming raw sewage.

Each unit will contain :

- A 6mm screening and compaction unit.
- A grit removal unit, via a classifying screw.
- A mechanized scum removal unit.

Each of the screens shall deliver their compacted screenings to their own containers.

The grit from each unit shall be removed and dumped into its own grit container.

The scum shall be pumped out and delivered to the scum sump.

All equipment shall be shaped and smoothed in a way that minimizes hydraulic losses.

The unit will contain all access ways and platforms, safety handrails and knee rails, kick plates, ladders, etc.

The unit shall be designed to withstand all static and dynamic loads that may be induced by equipment operation, personnel, and weather conditions.

All lubricating points on the driving mechanism shall be located such that no grease is deposited into the water inside the unit.

To facilitate the removal of units from the lines and/or prevent the transmission of vibrations from the machines, flexible and/or mechanical connections shall be provided where required.

Electrical insulation shall be incorporated inside pipe connections, for metal pipes from the structures and those outside, wherever there is a transition between overhead and metal underground pipes, and wherever there is a transition between pipes having different internal or external linings. Linings and coating of steel pipes shall be uniform.

Drive pulleys, and all types of bearings, shall have a B-10 lifetime of $\geq 100,000$ hours.

All metal supports for pipe work and Plant units under the Contract, shall be provided in the Bid.

Conditions of Operation:

- Liquid temperature : 12–40 °C
- Liquid pH range : 4–12
- Suspended solids : Up to 5% of grit removed from the classifier.

Bearings:

- Each motor and each rotating part, shall be equipped with permanently lubricated bearings.
- The B-10 life of the bearings shall be $\geq 100,000$ hours under normal operational conditions.

Screening and screenings compaction :

The mechanical screen shall be designed to treat raw sewage.

The screen shall have opening of 6mm.

The screen unit shall be of perforated rotating drum with integrated compacting unit or step screen with separated screw wash press.

Fibrous and solids (screenings) shall remain in the screen while the waste water will pass the screen. The screen, shall also have a top compaction section as part of it, so that the screenings will emerge out of it compacted and dewatered.

The screening system, shall operate in a continuous manner, whenever there is waste inflowing.

The screening compactor will be the top part of the screen unit.

The capacity of the compactor shall be sufficient to handle the entire quantity of solids, that will be removed from the incoming waste water.

The compactor shall be able to reduce the water content in the screenings by at least 90%.

The screw compactor shall have spray and washing fittings, connected to external supply of water, in order to reduce fecal products from the compacted screenings.

There shall be three spray and washing devices in each screen, fed by external supply of water filtered to 200 microns, each including solenoid valve, pipes, spray devices and control.

- The first device is used for washing of the basket, brushes and screw.
- The second device is used to wash the discharge of the compacting zone.
- The third one is spraying inside the compacting area, directly on the screenings under compaction, and used to wash the organics from the compacted screenings, in order to reduce fecal products from the compacted screenings.

The dewatered and washed screenings, shall be conveyed out of the machine via an outlet chute. The length of the chute shall be sufficient for conveying the solids to the transportable container without any additional equipment, while enabling easy maintenance of the machine.

The units will contain connections for all pipes for the spray washing to the compactor and for draining from it to the inlet channel, upstream of the screens.

The drive consists of a reducing gear (IP65) and an electric motor.

A sensor for detecting clogging shall be provided.

Sand & Grit removal :

Grit trap tank, laid out according to the ATV guidelines for a capture rate of 90% of 0.2mm grit particles and with a retention time of min 230 s. the unit should be aerated and sedimented material should be conveyed horizontally towards the inlet end of the grit trap. At the inlet end an inclined conveyor should be connected to discharge the sand.

The section of the sand and grit removal, is defined here as grit classifiers.

The classifier shall be capable of handling the total grit removal, at maximum flow conditions.

All piping and accessories for complete operation of the classifier, shall be part of the combined unit and provided by the Contractor.

The grit classifier shall be used for separating grit and other solid material from the water and discharging relatively dry grit into a transportable grit collection container.

The grit that has settled along the bottom, is collected to the inlet side of the classifier, by a horizontal collecting screw and from there, the grit is removed out of the machine, by an inclined shafted screw.

The discharge of the waterless grit, is higher than the wall of the unit and the grit is delivered by gravity to the grit container.

The discharge of the grit, shall be carried out via a chute, that will be above the side of the combined unit and above the height of the grit removal container.

This operation shall be carried automatically and intermittently, according to predetermined time intervals or to the grit accumulation.

The machine shall be actuated by electric motors. The motors shall comply with the electrical requirements.

The classifier shall be provided with grease nipples to enable daily greasing to be carried out.

All the bearings shall be designed to accommodate the total axial and thrust loading.

Scum removal :

Oil, fat and grease, are to be removed and separated from the incoming wastes. Skimming the scum floating off the surface, shall be done by means of an automatically operated skimmer blade, through a weir ramp to a pit hopper, wherefrom it will be pumped to mobile tankers and transported outside the WWTP premises.

Scum pumps:

The scum pumps shall include all the required pipes, valves, and all other accessories necessary to insure effective and efficient operation and maintenance of the complete system.

The scum pumps will be in operation for only several hours per day, in order to transfer the accumulated scum, to tanker trucks.

One pump shall be supplied, with the unit.

The specifications for the scum pump is as follows :

Type of Pump :

- Pumps shall be a positive displacement, progressive cavity.

Conditions of Operation:

- Liquid temperature : 12–40 °C
- pH : 4–12

Mechanical Seals:

- The pumps shall be equipped with mechanical seals of stationary and rotating rings, made of suitable materials, such as silicon carbide or silicon-silicon, that are suitable for the sewage liquid.

Bearings:

- Each pump shall be equipped with permanently lubricated bearings.
- The B-10 lifetime of the bearings shall be $\geq 100,000$ hours under normal operational conditions.

Materials of Construction:

- Housing : Epoxy-coated steel
- Rotor : SS316 hardened steel, or equivalent
- Stator : Buna N, Nitrile rubber, or equivalent

Operating time and starts :

- The pumps shall be capable of operating up to 12 start-stops per hour, and around the clock.

Installation :

- Motor, gear and pump, on a common base, attached to the floor of the pumping station.

Motor :

- 3-phase, 400 V.
- Service factor shall be 1.15.
- The motor shall be designed for at least 3 consecutive starts and 12 evenly spaced starts per hour.
- The motor shall be operated through a frequency converter.

Motor Protection :

- Thermal protection:
 - Each phase of the motor shall contain a temperature monitor to indicate overheating.
 - Bearings shall also contain such monitors.

Information to be Supplied with Pumps:

At a minimum, the Contractor shall submit with his proposal the following :

- Detailed description of pumps,
- Description of installation and any special arrangements, civil engineering works, grout, anchor bolts, etc., required for the installation,
- Operational curves of the pumps,
- Utilization instructions,
- Maintenance instructions,
- Recommended spare parts for 2 years of operation.

Drive Motors for all three functions :

- Power : To be determined by the Contractor
- Voltage : 400 V, 3 phase
- Frequency : 50 Hz
- Nominal current : To be determined by the Contractor
- Speed of rotations : To be determined by the Contractor
- Protection level : Min IP65 1
- Service factor : 1.15.
- Motors shall be designed for at least 3 consecutive starts and 12 evenly spaced starts per hour and for operation around the clock.

Pumps' Motors' Protection :

- Water in motor :
 - Electric probes shall indicate water presence in the oil sump of the motor.
- Thermal protection:
 - Each phase of the motor shall contain a temperature monitor to indicate overheating.
 - Bearings shall also contain such monitors.

Materials of Construction:

- All parts which come in touch with the waste water, shall be especially stainless steel 316L.
- Tanks : SS 316
- Impellers : SS316
- Shafts : SS316
- Bolts, nuts, etc. : SS316
- Guiding pipes : SS316
- The classifier, including all bolts, nuts, and washers, shall be Type 316 stainless steel, or better.
- The scum skimmer support structure and blades shall be fabricated from Type 316 stainless steel plate and profiles of 3 mm minimum thickness.

Electrical and Control Panel :

The screening system grit and scum shall come complete with its own electrical and control panel.

The panel shall contain all the required connections, hardware, and software necessary to operate and adjust the grit, scum and fine screening sections of this unit.

The panel shall be located adjacent to the system. It shall contain junction boxes with terminals, disconnecting switches, overload protection, etc., as per the definition of the electrical and control consultants.

The front door of the panel, shall include a touch screen, that will display all the relevant information and enable operation of the various parts of the combined unit. The size of the touch screen, will be not less than 16". All of the operation and control functions, as well as all indications of the positions of the various components, alarms, etc., shall be performed by a PLC.

The PLC shall be able to communicate with the main control system of the plant. The PLC shall be a common, readily available, commercial unit. Supply of the PLC shall include all necessary software loaded by the supplier, plus operator training by the supplier.

The door(s) of the local control panel and MCC shall be constructed and positioned in such a way that easy access to the equipment inside the panel is assured.

The control board shall conform to the local control section in the electrical specifications (Hebrew).

A panel light shall be included in order to illuminate the panel.

Sensors :

All sensors shall have IP66 protection and all external parts, except housing but including screws, shall be of stainless steel.

Operating Time:

- The system shall be capable of operating around the clock.

Installation:

- On a concrete slab.

Scope of Supply:

All necessary structural steel, screens, housings, motors, gears, electrical panels, cables, limit switches, machinery, platforms and supports, ladders etc., shall be included together with other materials, anchors, and clamps.

- All electrical installations and facilities required for the proper functioning of the system, as stipulated in the specification or as implied by the operational control requirements.

- All mechanical and electrical safety enclosures and apparatus required for equipment protection or personnel protection, as provided for in the specification and according to international standards and local laws.
- A set of special tools and jacks for maintenance.
- Spare parts for 2 years of operation.
- Instruction manuals and technical documentation

Dimensions & connections :

- All dimensions and weights of the units shall be supplied, including any pipe connections, electrical connections etc.

Information to be supplied with the system:

At a minimum, the Contractor shall submit with his proposal the following:

- Detailed description.
- Description of installation and any special arrangements, civil engineering works, anchor bolts, etc., required for the installation.
- Recommended spare parts for 2 years of operation

Submittals :

At a minimum, the Contractor shall submit with his proposal the following:

- Descriptive literature, bulletins, and/or catalogs of the equipment.
- Description of installation, operation and maintenance.
- Complete data on the characteristics and performance of each piece of equipment. Data shall include guaranteed performance curves or figures, based on actual field performance of similar units that show that they meet the specified requirements for each piece of equipment.
- Complete motors data.
- Electricity consumption.
- If special materials of construction are used, data demonstrating compatibility with the requirements, capability to withstand the corrosive liquids and solids that they will be in contact with, and capability to withstand the existing outside environment.

Testing :

Shop Testing :

All of the above mentioned major equipment such as the screens and compactors and grit and scum removal units, shall be certified before shipment by the manufacturer or by an approved testing laboratory, as ordered by Trust Agency personnel that shall be hired by the manufacturer. The shop certification shall be conducted in the presence of Trust Agency personnel. All payments for the tests and for the Trust Agency shall be at the sole expense of the Contractor.

All other equipment, such as the pumps shall be tested by the manufacturer or by an approved test laboratory.

The certification shall include approval that the proposed equipment is identical to the requirements of the specifications, that materials are in accordance with requirements and the level of manufacturing is satisfactory. The trust agency will sign each page of the relevant specification indicating complete compliance.

Shipment of equipment shall be allowed only after the Contractor obtains a certified statement of approval submitted by the Trust Agency or by the manufacturer, as the case may be, including certification of test results.

Site Testing :

Manufacturer's representative :

Services of the manufacturer's representative shall be provided by a service engineer specifically trained on the type of equipment to be supplied. Cost of these services shall be at Contractor's expense.

Services to be provided are as follows :

- Checking the installation of all components before power is applied.
- Supervising the placement into operation of each piece of equipment, and making any necessary adjustments.
- Providing O&M and safety instruction and training to Client's personnel, covering all equipment. A minimum of two man-days of instruction shall be provided.

Measuring instruments etc. :

All measuring instruments, indicators, and any other apparatus, as well as all labor, lubricants, etc., required for site testing, shall be provided by the Contractor. All measuring instruments shall be attested as having been calibrated by an approved testing institute or otherwise to the satisfaction of the Engineer.

Site tests, shall consist of testing and inspection activities to be carried under wet conditions by the Contractor and witnessed by the Client's Representative. The Contractor shall supply the electrical power and the clear water and fill the structure. The tests shall indicate full compliance of the Plant with the requirements of the Contract Documents. As a minimum, the following tasks shall be required:

1. Dry Test :

- Check on specified clearances, deflections and other design and/or operating parameters under normal loading conditions.
- Check that the system operates successfully for a minimum period of 8 hours with a simulated live load.
- Check the operation of the scum components.
- Check the operation of the grit components.
- Check the operation of the screening components.

- Check on current and other electrical performance data of all motors and other electrical and control equipment when operating under live load conditions.
- Check for excessive noise, vibrations, wear, and misalignment of all moving components of the Plant.

2. Under actual conditions – Wet Test :

- The systems shall operate continuously during 350 hours with raw wastewater, without any malfunction. A malfunction is defined as any fault in the electromechanical, electric or control systems for more than two hours. In any case, if the component fails more than four times (for less than two hours each time), it will be considered as a malfunction.
- The removal rate of grit will be at least 90% of particles bigger than 0.2 mm.
- The removal rate of oil and grease will be at least 70%.

411.3.8 - Fine screen (3mm ÷ 1mm)

This specification is for the supply, of a complete fine screens system, as per the following description :

The fine screen units will be fed by raw waste water, that has passed through a pretreatment units.

The fine screen units will be fed by gravitation.

Fibrous and solids (screenings) shall remain in the fine screen while the waste water will pass the screen. The fine screen, shall also have a top compaction section as part of it, so that the screenings will emerge out of it compacted and dewatered.

The fine screening system, shall operate in a continuous manner, whenever there is waste inflowing.

The screening compactor will be the top part of the fine screen unit.

The capacity of the compactor shall be sufficient to handle the entire quantity of solids, that will be removed from the incoming waste water.

The compactor shall be able to reduce the water content in the screenings by at least 90%.

The spiral compactor shall have spray and washing fittings, connected to external supply of water, in order to reduce fecal products from the compacted screenings.

The dewatered and washed screenings, shall be conveyed out of the machine via an outlet chute to the transportable container, without any additional equipment, while enabling easy maintenance of the machine.

There should be no additional drive unit, at the top of the spiral compactor.

All pipes for spray washing to the compactor and for draining from it to the inlet channel, upstream of the screens, shall be part of this contract.

A sensor for detecting clogging shall be provided.

Products from the fine screens :

The fine screens will produce filtered effluents, having particles smaller than 1.0 mm and compacted and dewatered solids, having solids concentrations of at least 60%.

Conditions of Operation:

Liquid temperature : 12–40 °C
pH : 4–12

General description of the fine screen units :

The fine screen units will be of an inclined rotating screen basket. Each unit will be composed of the following main parts :

- A screen basket,
- A screenings elevating screw that turns into a screening compacting screw.
- A high pressure water system for washing the screen,
- A high pressure water system for washing of screenings,
- A motor – gear assembly, to rotate the rotating assembly. The motor shall be suitable to be operated by a frequency converter.

Following are specifications for the main parts of the fine screens :

The screen basket :

The screen shall be perforated with spacing of 1.0 mm.

The entire flow enters the screen drum through its open front end and the filtrate can only leave the drum through its screen area. This will guarantee, that the screenings are always retained within the screen drum.

The screenings elevating and compacting screw :

A screw will pick and elevate the screenings inside an inclined pipe.

The spiral will be composed of more spacious windings at the bottom and within the basket and ever growing windings' density, for compaction.

The screw will be snugly installed inside a pipe, that will allow its free motion, but prevent screenings from back falling down.

A high pressure water system for washing the screen :

The screen will be washed through suitably installed nozzles by tertiary water, that will be supplied by others.

Each of the fine screens, will be supplied with a high pressure water pump, piping, valves etc., to enable periodic washing of the screen.

The surface is cleaned by spray nozzles as the basket is rotating.

The filters motor – gear assembly :

- The motors shall be 3-phase, 400 V, 50 Hz, as per the required rpm.
- All motors shall have a 1.15 service factor.
- Motors will be suitable for operation through a frequency converter, with a control of 4–20 mA signals.

- Gears will be adequate to provide the maximum required speed. The gears power should be double that of the motor.

All of the above equipment shall be included in the proposal, along with all other items necessary to form a complete and efficient system for adequate operation and maintenance.

Any additional equipment necessary for the proper operation of the proposed installation, not specifically mentioned in these specifications, shall be furnished and installed, as part the main offer and at no additional cost to the Client.

General Information Regarding the Supply of Equipment :

The following are some general details and conditions that the manufacturers and suppliers of the fine screens for this project, shall pay attention to and consider when selecting the equipment they are offering to supply :

Safety :

All equipment should be designed for safe operation and maintenance.

Operating Time:

The system shall be capable of operating around the clock.

Lubrication :

- All lubrication points, such as grease nipples, oil replacement, etc., shall be in locations that allow easy and safe access.
- Oil filling plugs shall be placed at the highest point of the unit.
- Oil draining plugs shall be placed at the lowest possible point of the housings.
- Suitable means of determining oil levels, either by a dipstick or by oil level window, are to be easily accessible for measuring / reading.
- Oil level indicators shall be located in free and observable locations.
- Oil removal valves or plugs shall be located such that no oil will leak into the water that is being treated.
- All lubricating points on the driving mechanism shall be located such that no grease is deposited into the water inside the unit.

Materials of Construction (MOC) and Corrosion Protection :

- All the elements in the fine screens, shall be made of 316 stainless steel.
- High pressure pumps shall be made of 316 stainless steel.
- Pipes and other parts of the screens shall be made of 316 stainless steel.
- Rinsing water piping, shall be made of 316 stainless steel.
- All bolts and nuts, anchor bolts etc., shall be made of 316 stainless steel.

Bearings :

- Bearings manufactured by SKF are preferable.
- All bearings shall be anti-friction ball- or roller-type, designed for a B-10 lifetime of at least 100,000 hours.
- All the bearings shall be designed to accommodate the total axial and thrust loading.

Motors protection :

IP65.

Hydraulic design :

All equipment shall be shaped and smoothed in a way that minimizes hydraulic losses.

Mechanical robustness :

The units shall be designed to withstand all static and dynamic loads that may be induced by equipment operation, personnel, and weather conditions.

Maintenance :

- All equipment shall be designed so as to allow easy and safe access for inspection and maintenance.
- The equipment shall be supplied with lifting "ears", that will enable it to be lifted to ground level and placed on the pavement for service.

Spare Parts :

All equipment shall be offered with a separate list of spare parts for two years of operations. In addition, the manufacturer shall ensure additional supply of spare parts for at least five more years of operation.

Automatic & manual operation :

The waste water treatment plant is designed to be operated in a fully automatic manner. However, all the electrical equipment, shall have a manual override over the automatic control system for routine maintenance and for emergency situations.

The operation of the fine screens, namely the rotation and wash, will be monitored by the water level, upstream of the filters.

The water level will be measured by a water level indicator – transmitter, that will be supplied by others.

The water level will determine the rotation speed and the wash and will be controlled by the main computer of the WWTP.

Selection of Manufacturers :

- All the specified equipment, shall be products of manufacturers regularly engaged in the production of such equipment.
- Where specified, only mentioned manufacturers of equipment shall be proposed.
- Like items of materials/equipment shall be the end product of a single manufacturer to the extent possible, in order to provide standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.
- The Contractor shall have the sole responsibility for the proper functioning of the equipment as furnished.

Warranty :

A warranty period of 24 months after commissioning of the plant is required for all the equipment.

A period of 5 years after the warranty period completion is required to supply all spare parts.

literature :

The contractor shall provide a full set of literature and assembly instructions, as well as maintenance instructions.

The literature will include :

- In general : Complete data on the characteristics and performance of each piece of equipment. Data shall include guaranteed performance curves or figures, based on actual field performance of similar units that show that they meet the specified requirements for each piece of equipment.
- Detailed description of the equipment.
- Description of installation and any special arrangements, civil engineering works, grout, anchor bolts, etc., required for the installation.
- Operational curves of the pumps.
- Operational instructions.
- Maintenance instructions.
- All dimensions and weights of the units shall be supplied, including any pipe connections, electrical connections etc.
- Complete motors data.
- Electricity consumption.

Materials of Construction:

- All parts which come in touch with the waste water, shall be especially stainless steel 316L.
- Screen drum : SS316
- Shaft : SS316
- Screw : SS316
- Bolts, nuts, etc. : SS316
- Guiding pipes : SS316

Electrical and Control Panel :

The three screens shall come with complete electrical and control panel and three local control panels.

The panel shall contain all the required connections, hardware, and software necessary to operate and adjust the grit, scum and fine screening sections of this unit.

The panel shall be located adjacent to the system. It shall contain junction boxes with terminals, disconnecting switches, overload protection, etc., as per the definition of the electrical and control consultants.

The front door of the panel, shall include a touch screen, that will display all the relevant information and enable operation of the various parts of the combined unit. The size of the touch screen, will be not less than 16".

All of the operation and control functions, as well as all indications of the positions of the various components, alarms, etc., shall be performed by a PLC.

The PLC shall be able to communicate with the main control system of the plant. The PLC shall be a common, readily available, commercial unit. Supply of the PLC shall include all necessary software loaded by the supplier, plus operator training by the supplier.

The door(s) of the local control panel and MCC shall be constructed and positioned in such a way that easy access to the equipment inside the panel is assured.

The control board shall conform to the local control section in the electrical specifications (Hebrew).

A panel light shall be included in order to illuminate the panel.

Sensors :

All sensors shall have IP66 protection and all external parts, except housing but including screws, shall be of stainless steel.

Operating Time:

- The system shall be capable of operating around the clock.

Installation:

- On a concrete slab.

Scope of supply :

The Contractor shall supply the complete fine filtration systems, with all its components, ready for assembly and operation.

Screw Conveyor

The manufacturer shall supply screw conveyor for the purpose of conveying cake sludge. Included in this item are all related equipment and accessories needed, including motor, drive, structural supports, controls, guards, wash-water solenoid etc. The screw conveyor shall be capable of conveying cake sludge at a rate at least as great as the maximum production rate.

The screw conveyor shall include a center shaft. Furthermore it will include a trough, cover (to extend the entire length of the screw conveyor), fixed inlet hopper, screw drive motor and assembly, pivot mechanism drive motor and assembly, discharge chute, and all necessary controls, guards, structural supports, safety devices, etc.

The Screw conveyor shall be of the double flight type; deflections between standard hanger bearing intervals (such intervals not to exceed 3.5 meters) shall not exceed ¼". Extended grease piping through the trough cover to convenient access points shall be provided. Bearings shall be of the flanged external ball bearing type with grease fitting and external gland seal. Minimum L-10 bearing life shall be 100,000 hours.

The speed gear reducers of the conveyor drive motor shall be V belt or chain belt input to the conveyor drive shaft. Gears shall be at least as per AGMA II (with splash lubrication provided as a minimum). The V-belt or chain belt assembly shall be provided with an FRP guard. The gear reducer and drive shall be provided with an instantaneous trip current relay for torque overload protection.

The screw conveyor cover shall not impede or obstruct the sludge flow and shall be easily removable for inspection and maintenance.

The screw conveyor center shaft, fittings, trough, cover, inlet hopper, and discharge chute shall all be manufactured of minimum 316 stainless steel. All metal parts which are not stainless steel shall be Hot-Dipped Zinc Galvanized.

The screw conveyor shall operate whenever the centrifuge it is serving is in operation and controlled from its control panel. The conveyor shall shut down automatically after the centrifuge it is serving has shut off, but only after a time delay, to permit the removal of all cake sludge remain in the screw.

Testing :

Shop Testing :

All of the above mentioned major equipment, shall be certified before shipment by the manufacturer or by an approved testing laboratory, as ordered by Trust Agency personnel that shall be hired by the manufacturer.

The shop certification shall be conducted in the presence of Trust Agency personnel. All payments for the tests and for the Trust Agency shall be at the sole expense of the Contractor.

All other equipment, such as the pumps, shall be tested by the manufacturer or by an approved test laboratory.

The certification shall include approval that the proposed equipment is identical to the requirements of the specifications, that materials are in accordance with requirements and the level of manufacturing is satisfactory. The trust agency will sign each page of the relevant specification indicating complete compliance.

Shipment of equipment shall be allowed only after the Contractor obtains a certified statement of approval submitted by the Trust Agency or by the manufacturer, as the case may be, including certification of test results.

Services of the manufacturer's representative shall be provided by a service engineer specifically trained on the type of equipment to be supplied.

Cost of these services shall be at Contractor's expense.

Services to be provided are as follows :

- Checking the installation of all components before power is applied.
- Supervising the placement into operation of each piece of equipment, and making any necessary adjustments.
- Providing O&M and safety instruction and training to Client's personnel, covering all equipment.

Site Testing :

All measuring instruments, indicators, and any other apparatus, as well as all labor, lubricants, etc., required for site testing, shall be provided by the Contractor. All measuring instruments shall be attested as having been calibrated by an approved testing institute or otherwise to the satisfaction of the Engineer.

Site tests, shall consist of testing and inspection activities to be carried under wet conditions by the Contractor and witnessed by the Client's Representative.

The tests shall indicate full compliance of the systems with the requirements of the Contract Documents. As a minimum, the following tasks shall be required:

1. Dry Test :

- Check on specified clearances, deflections and other design and/or operating parameters under normal loading conditions.
- Check that the system operates successfully for a minimum period of 8 hours with a simulated live load.
- Check the operation of the fine screening components.
- Check on current and other electrical performance data of all motors and other electrical and control equipment when operating under live load conditions.
- Check for excessive noise, vibrations, wear, and misalignment of all moving components of the Plant.

2. Under actual conditions – Wet Test :

The systems shall operate continuously during 350 hours with raw wastewater, without any malfunction. A malfunction is defined as any fault in the electromechanical, electric or control systems for more than two hours. In any case, if the component fails more than four times (for less than two hours each time), it will be considered as a malfunction.

411.4 - Diffuser Assemblies

This specification is for the supply of fine bubbles diffusion systems, that will be inserted in the aerobic reactors.

Air Supply System :

The aerobic reactors, will receive the air supply from blowers, that will feed the air main, subsequently the drop legs and from them, distributed to the diffusers.

The number of drop legs per each reactor, will be determined by the Supplier.

The aeration system will be designed so as to insure uniform distribution of the air, throughout the entire cross section area of the reactors. Also, it shall be capable of complete and uniform mixing and suspension of the mixed liquor suspended solids, at MLSS concentrations of 3,000 to 12,000 mg/l, throughout the entire cross section area of the aeration reactors.

Air flow rates and mixing rates shall be variables over the range necessary for oxygen transfer and mixing.

It is hereby emphasized, that it is the sole responsibility of the contractor, to offer all the electromechanical equipment, as partially listed below.

The Contractor shall supply fine bubble perforated membrane diffuser systems and all the related pipe work and other equipment for assembly in the aeration tanks.

Within the available floor area, Suppliers may propose diffuser layouts as they see fit, using diffusers, subject to the following guidelines :

- The diffusers in each tank must be capable of delivering the complete air flow rate, which is required by the process, in standard conditions.
- The standard oxygen transfer efficiency (SOTE) of the diffusers must be at least 30%.
- At the designed flow rate, the flow rate per diffuser shall not be greater than the 50% mark of the diffuser's standard flow rate range, as published in the manufacturer's specifications. (For example, if the diffuser's published flow rate range is 2.0-6.0 Nm³/h, the maximum design flow rate per diffuser which could be used by the Supplier in this project is 4.0 Nm³/h/diffuser). Suppliers must, within their offers, include the manufacturer's published specifications stating the proposed diffusers' standard flow rate range.
- The layout of the diffusers must offer easy and convenient access to the diffusers, pipe work, valves and related equipment for both the initial assembly and for subsequent operation and maintenance activities.

411.4.1 General

The diffuser membranes shall be one-piece, compression molded parts made of the elastomeric material EPDM, or better.

Suppliers are encouraged to include with their offers a description of the material characteristics of the membrane which have been enhanced, by the inclusion of proprietary or other additives. In particular, the resistance of the membrane to chemical attack, weathering and aging should be addressed.

The diffusers systems shall be designed such that the membrane collapses onto its support, when air flow to the assembly is shut off. The collapse of the membrane shall seal the air inlet

system and prevent back flow of water and deposition of solids into the membrane perforations.

Diffuser membranes shall be secured to diffuser holders made of PVC or equal. Suppliers shall provide detailed drawings to show how the membrane is held in place and how the escape of air at the membrane-holder interface is prevented.

Complete edge support for the membrane shall be provided. The method of securing the membrane to the holder shall generate a minimum of 50 pounds per inch of circumference.

Diffuser holders which do not allow for the easy replacement of the membrane will not be accepted.

411.4.2 - Pipework and Related Equipment

The pipe work and related equipment under this Sub-clause for each of the tank shall include :

- Electric proportional valve.
- Submerged drop pipes sections; a grid air manifold; air distribution headers onto which the diffuser assemblies will be attached; supports and appurtenances.

The unit price per grid of diffuser assemblies to be entered in the Bill of Materials shall include all the required pipe work and related equipment specified herein or otherwise necessary for the proper functioning of the Aeration System.

The submerged pipe work and fittings (including grid air manifold and air distribution headers) shall be PVC, conforming to ASTM D-2241 or D-3034, as applicable, and shall be ultraviolet stabilized with a minimum of 2 percent titanium oxide (TiO₂).

Maximum length of any one section of pipe work shall be 60 feet. All connections between pipe sections, pipe and fittings, or fittings, shall be **gusted**, mechanical expansion joints designed to allow for thermal expansion and contraction up to temperatures of 110°C.

The submerged drop pipe sections should be stainless still 316 .the grid air manifold and the air distribution headers shall all be supported by ANSI 316 stainless steel supports designed to withstand ten times the normal uplift forces; spacing of supports shall not exceed 2.5m.

411.4.3 - Fixed diffusion systems :

The grid air manifold shall be fabricated with a fixed joint connection for each of the air distribution headers. For fixed diffusion systems, manifold supports shall include manifold hold-down, guide straps, anchor bolts and supporting structures. Guide straps shall be a minimum 2" wide. The supports shall be equipped with an alignment mechanism, capable of allowing a ± 2 " vertical adjustment of the manifold in the field. The supports shall be completely removable from the tank (less the anchor bolt) to facilitate the cleaning and maintenance of the tank bottom.

The air distribution header supports may be of the guide or fixed type and must allow for the expansion of the system. The supports shall be equipped with an alignment mechanism capable of allowing a ± 1.5 " vertical adjustment of the headers in the field. The alignment mechanism shall be infinitely adjustable within its limits to allow the precise leveling of the headers and the diffuser assemblies to within $\pm 1/4$ " of a common horizontal plane without removing the header from the support.

Anchor bolts shall be stainless steel, expansion type, with a pull out strength design safety factor of at least 4.

Included in the supply under this Sub-clause shall be an airlift (condensate) purge system for each grid to allow the grid's entire submerged aeration piping system to be drained. The purge system shall include a PVC drain-line, sump, airlift purge eductor line and eductor carrier column. Each aeration grid shall be constructed with an integral drain-line terminating at the sump.

411.4.4 Diffuser Assemblies Tests

- (a) The Supplier shall, together with his offer, submit factory test data documenting the SOTE guaranteed in the Schedule of Particulars and Guarantees. Test conditions (regarding diffuser density, airflow rate, etc.) may be more conservative - but shall not be less so - than the actual design conditions in this project.
- (b) The factory test outlined in (c) below shall be conducted using some of the actual diffusers to be supplied (test diffusers to be selected at random by the Owner). All costs of the test shall be borne by the Contractor (including but not limited to travel, lodging and board expenses for one representative of the Owner to be present as a witness for the duration of the test).
- (c) The diffusers shall be factory tested to prove their compliance with these specifications and with the Supplier's entries in the Schedule of Particulars and Guarantees. Particular emphasis shall be placed on documenting the Supplier's claimed SOTE. The test to establish the diffusers' SOTE shall be conducted in a tank with a minimum surface area of 10 square meters of surface area and at a diffuser submergence and density ($AD/AT = \text{total diffuser surface area} / \text{divided by the tank floor surface area}$) equal to actual project conditions. To minimize wall effects, the tank shall be of square cross-section. In all respects, test conditions shall faithfully replicate actual project conditions.

The test shall be conducted in accordance with the latest ASCE Clean Water Test Procedure. All parameters (temperature, pressure, etc.) entering into the calculations shall be measured and documented. The existence of any nonstandard conditions shall be permitted only insofar as the Supplier proves, to the satisfaction of the Owner, that such condition(s) have been compensated for by the use of appropriate calculations.

The diffusers shall be tested at the design air flow rate (i.e., the rate needed for all of the project diffusers to be able to supply the required flow rate in the actual aeration tanks; rate not to exceed the 50% mark of the manufacturer's standard published diffuser operating range). The required oxygen transfer capacity of the test diffuser shall be calculated based on the number of test diffusers, the design air flow rate, and the SOTE claimed by the Supplier in his Schedule of Particulars and Guarantees.

Three (3) test runs shall be conducted; the average SOTE demonstrated in the three tests will be used to assess possible penalties, as outlined in paragraph (e) below.

Airflow shall be measured with two separate types of devices; sharp-edged orifice plate, flow tube or similar device shall be used. The air flow meters shall be calibrated prior to use; a certified calibration shall be submitted to the Owner. System's pressure shall be measured to within one tenth of an inch of water column using a direct reading manometer.

Test tank shall be filled with water, with test water temperature measured at least twice per test run. The tank shall be de oxygenated for testing using anhydrous sodium sulfite. Technical grade cobalt chloride shall be used as a catalyst for the deoxygenation.

Fast response dissolved oxygen probes (minimum: four (4) probes) shall be used for the oxygen concentration measurements. Probes shall be calibrated with test water; a certified calibration shall be submitted to the Owner. The calculations to be performed using the test data shall follow the Non-linear Regression Method as outlined in the ASCE standard "Measurement of Oxygen Transfer in Clear Water" July 1984.

The Supplier's written report detailing and summarizing the test, complete with all necessary calculations, shall be submitted to the Owner within two (2) weeks of the test date.

- (d) The Owner reserves the right to require the performance of the test outlined in (c) above before the acceptance of any offer. In this case, the test diffusers need not be drawn from the actual diffusers to be supplied (but should be identical to same). In the event a pre-offer-acceptance test is conducted, and if the Supplier's offer for this Part is later accepted, the pre-offer acceptance test shall be deemed to be in lieu of the test required in (c) above. The Supplier shall bear all costs of the pre-offer acceptance test, as above, regardless of whether the diffusers pass the test or not, and regardless of whether the Supplier's offer is accepted or not.
- (e) In the event the Contractor's offer for this Part has been accepted, and in the event the diffusers' tested SOTE is greater than 30% but less than the SOTE guaranteed by the Contractor in his Schedule of Particulars and Guarantees, the following penalty shall apply. This penalty shall in no way be considered as a waiver on the part of Owner to materialize any of his rights under the Contract, either with respect to acceptance of the equipment or with respect to any other claim of the Owner's due to the Contractor's failure to comply with any of the conditions of the Contract or to fulfill his assigned responsibilities. For every 1% of negative deviation in the diffusers' tested SOTE, based on an average of the three tests run, from the SOTE guaranteed in the Schedule of Particulars and Guarantees, the penalty on the Contractor shall be calculated at a rate of 1% of the sum entered in the respective Sub-clause (in the Bill of Materials). Important Note : The percentage of negative deviation, refers to the SOTE guaranteed, and is not on the basis of 100% SOTE. For example, if a SOTE of 30% is guaranteed, a tested SOTE of 28% will be understood as constituting a 4% negative deviation and not a 1% negative deviation. In addition, diffusers whose tested SOTE shows a negative deviation of more than 15% from the SOTE guaranteed in the Schedule of Particulars and Guarantees will be rejected.

411.4.5 Automatic Control Valves

The Contractor shall supply an automatic control (modulating) valves, for each aeration tank. The valves shall be located in the main air supply manifolds to the tanks.

The valves shall be powered by electric actuators, consisting of an electric motor driving through a gear train to power the valve stem or shaft. The actuators shall be equipped with a hand wheel for manual operation, in case the motor is disabled or

manual operation is preferred. The hand wheel shall be rendered inoperative if the motor is currently in operation. All supporting installations needed for the valve, the actuator and the integral local control panel, shall be included in the supply under this Sub-clause, as shall all related hardware, mounting fixtures and fittings.

The actuator shall be capable of receiving a 4-20 mA input signal from the plant's Central Control Panel (CCP) and positioning the valve accordingly. In addition, the actuator shall be capable of transmitting back to the plant's CCP, in a 4-20 mA signal, the valve's position indication. Local position indication display shall also be included.

The actuator shall be capable of transmitting back to the CCP the selector switch setting (on-off manual), such switch to be integrated into the local control panel.

The actuator shall be flameproof and watertight to IP68. Actuator motors shall satisfy Clause herein. Actuators shall be equipped with switches and knobs which operate on a magnetic principle, rather than with mechanical hardware which penetrates the protective seal of the unit. The terminal boxes of the actuators shall be double sealed.

The actuator motor shall have a minimum of 25% spare power above the nominal rating of the valve.

The actuators shall be equipped with torque-limiting switches for both open and closed positions, and four train limit switches to position the valve for seating. It is stressed that the torque overload protection, limit switches, contactors, relays and all other electrical protection devices, equipment and controls shall be provided by the actuators' own local control panels, not by the plant's CCP. The plant's CCP will supply only power and the above-mentioned 4-20 mA position command signal to the actuators.

All electric and motor control equipment required for the proper functioning of the actuators shall be included in the actuators' local control panels. Torque overload and limit switches shall operate on an electronic (not mechanical) basis.

The control valves shall be capable of infinitely-variable positioning between their full-open and full-closed positions. The actuator, in addition to being capable of automatic control, shall also be capable of local (manual) electric control via an "inching" electrical assembly which opens or closes the valve over its infinitely-variable range only so long as the appropriate button is kept depressed. In addition, the local manual electrical actuation of the valve shall be designed to completely open or completely close the valve with a single touch of the appropriate button, with no need to keep the button depressed during the entire operation.

Actuator selector switches shall be lockable.

411.5 - Blowers :

411.5.1 - General

The work in this chapter includes providing positive displacement blowers and all appurtenant work, complete and operable, with all necessary accessories, tools, drives, piping, fittings, valves, connectors, safety devices, and controls, to obtain a workable installation suitable for continuous operation 24 hours per day, as indicated.

The blowers shall supply **oil free** air to the aeration basin.

System Design :

Operating Conditions

The operating conditions of each of the positive displacement blower's, shall be as follows :

- Inlet conditions : Elevation of ____ m above sea level
- Humidity : 53–67% average
100% maximum
15% minimum
- Temperature : 45 °C maximum (day)
5 °C minimum (night)
28–38°C summer average
- Minimum overall efficiency : 75%
- Noise level : Specified section 400.2.3.
- Maximum blower speed : The speed of operation at working point shall not exceed 80% of the maximum allowable speed of the blower.

Description of the Equipment :

Equipment Requirements :

Positive displacement blowers shall be of rotary, 3-lobe, involute design, suitable for continuous operation of 24 hours per day. All blowers shall be based upon data previously established by tests in accordance with the ANSI/ASME PTC 9 performance test code.

The blowers shall be suitable for outdoor installation.

The blowers shall consist of a cast iron casing and cast iron in volute impellers.

The blowers shall be supplied as a package unit with the following accessories :

Drive :

V belts :

The drive shall be through V-belts, with a minimum of two belts and belts guards.

Motor :

A heavy-duty, high-efficiency electric motor, suitable for indoor or outdoor installation, for 400 volt, 3-phase, 1,500 rpm at 50 Hz supply.

The motor shall be suitable to be operated by a frequency converter.

The blower's motor shall be mounted horizontally and it shall comply with the electrical requirements.

The noise level from each blower shall be less than 80 dBA at a distance of 1 m outside of the acoustic enclosure.

Accessories:

Each blower shall be furnished as a complete unit, assembled on a suitable base frame, with the following minimum accessories, all necessary pipes, fittings, supports, controls, and other components, as indicated :

- An air intake filter with support and disposable filters. Inlet filters shall be dry, washable panel-type with felted synthetic media mounted in galvanized steel frames. Filters shall stop 99% of 10 micron particles.
- Filter clogging indicator
- An inlet silencer
- A Discharge silencer
- A Differential pressure indicator on the inlet filter
- A set of spring-type, restrained, heavy-duty vibration isolators
- Two stainless steel, braided, flanged flexible connectors, not less than 9" long
- A pressure relief valve
- A non-return valve, equipped with a limit switch
- A butterfly valve, suitable for hot gases
- A pressure gauge, with valve for the discharge line
- A pressure indicator and transmitter for the discharge line (4–20 mA)
- An air flow rate meter (4–20 mA), will be supplied for the aeration system
- An electrical valve installed after the pressure relief valves for automatic zero pressure start
- A temperature transmitter (4–20 mA) for the aeration system
- Flexible connections, as necessary
- An emergency stop button
- A base frame with forklift slots
- An acoustic enclosure with mounted cooling fan

Equipment Construction:

Basic equipment construction and materials required shall be as follows :

- Impellers – cast-iron, machined, permanently fastened to steel shaft, dynamically balanced
- Head plates – cast-iron, machined and ground internally to close tolerances
- Impeller case – cast-iron, machined, with heavy rib reinforcement, vertical or horizontal style
- Bearings – anti-friction bearings with thrust control, rated for a B-10 lifetime of $\geq 100,000$ hours

- Timing gear – steel, accurately cut and bolted to timing hub
- Lubrication – oil splash lubrication from oil-tight housing. Drive-end bearings may be grease lubricated, with lip-type seals.
- Driveshaft – extended steel shaft for V-belt drive
- Drive – V-belt drive, with steel safety guard
- Base – heavy cast-iron or fabricated steel base, common for blower and motor

Installation :

The complete blower assembly shall be mounted on a common base plate suitable for mounting on a concrete base pad.

Submittals :

At a minimum, the Contractor shall submit with his proposal the following:

- Performance curve (and data) indicating points on the H/Q curves, and the limits recommended for stable operation between which products may be operated without surge and vibration. The stable operating range shall be as wide as possible.
- Electrical data, including control and wiring diagrams
- Assembly and installation drawings, including shaft size, seal, coupling, anchoring details, part nomenclature, material list, outline dimensions, and shipping weights

Testing :

All of the abovementioned equipment shall be tested before shipment by the manufacturer or by an approved test laboratory, as ordered by Trust Agency personnel that shall be hired by the Contractor. The shop testing shall be conducted in the presence of Trust Agency personnel. All payments for the tests and for the Trust Agency shall be solely at the expense of the Contractor.

Shipment of equipment shall be allowed only after the Contractor obtains a certified statement of approval submitted by the Trust Agency, including certification of test results.

The work shall include equipment testing as follows:

Tests shall be performed in accordance with the ANSI/ASME PTC 9 and PTC 10 performance test codes. Prototype model tests are not acceptable. All tests performed in the factory shall be certified by the manufacturer and submitted by the Contractor for approval, prior to shipment.

Performance Tests :

The most important of all are the performance tests, in which the equipment, each component as well as the system as a whole, must operate under actual plant conditions, with the actual waste slurry, etc., as per the specification.

The performance tests shall be carried out along the complete designed operating range.

The performance tests shall be carried out in the presence of both the plant's authorized personnel and the manufacturer's authorized representative.

The duration time of the performance tests shall be defined prior to awarding the supply contract.

The tests to be performed under actual condition – Wet Test shall be as outlined below:

- The aeration reactor together with the internal circulation pump and the mixers, shall operate continuously for 700 hours with primary effluent without any malfunction. A malfunction is defined as any fault in the electromechanical, electric or control system for more than two hours.

In any case, if the component fails more than four times for less than two hours each time), it will be considered as a malfunction.

- The secondary effluent during the 700 hour test shall not exceed that required by the tender documents.
- The specific energy of the system shall not exceed 0.4 kw per m³.
- The SVI (Sludge volume Index) shall not exceed 150 ml/gram
- The time required for development of perfect mixing conditions inside the reactor from the start of operation of the aeration/mixing system shall not exceed 5 minutes at 10,000 mg/l. The difference between the concentrations of the suspended solids at any two sampling points inside the reactor under conditions of aeration shall not exceed 10% under varying conditions.

411.6 - Pumping equipment

411.6.1 General Requirements for All Pumps

Suppliers of pumps shall pay attention and adhere to the following general requirements:

Scope of Supply:

- The supplier of any pump, shall supply all the parts which are required, so that the pump will be ready for installation and operation, including base plates, cables, guiding pipes, base elbows as needed, couplings, guards, etc.

Balancing:

- The rotors shall be dynamically balanced, so as to avoid any vibration during operation.

Couplings:

- Couplings between motors and pumps shall be by belts, or, when the two shafts are aligned, by a spring Falk-type coupling.
-

Noise Emission:

- All pumps, motors, or any other related equipment that will be outside the water, shall emit a noise level that will be lower than 80 dBA beyond a distance of 1 meter from the equipment.

Instrumentation:

- All motors shall include temperature probes.
- For submersible motors, water detectors shall also be included.

Service Factor:

- All motors shall have a service factor of 1.15.

Special Requirements:

- Manufacturers shall indicate any special requirements for sump design and anti-vortex arrangement for the suction of the pumps, including separation walls, screen walls, inlet arrangements, etc.

Mechanical Warranty:

- The Contractor shall guarantee the pump, including all of its components, for a minimum period of 24 months of operation under normal operating conditions. This shall include workmanship, smoothness of operation, corrosion, etc.

Bearings:

- B-10 lifetime of bearings shall be $\geq 100,000$ hours.

Mechanical Seals:

- All pumps shall be equipped with mechanical seals silicon made. Lifetime of mechanical seals shall be $\geq 40,000$ hours.

Spare Parts:

- Contractor shall recommend a list of spare parts for 2 years of operation.

Materials of Construction:

- All pumps and pumps components shall be made of materials capable of withstanding the waste water corrosive environment.
- SS316 shall be used for parts that are in constant touch with liquids.
- For external parts, steel can be used, provided it is protected by paint coatings of a quality and thickness that will not allow corrosion to deteriorate the parts. (An example of such protection is as follows: All steel parts shall be steel blasted to SA 2.5/DIN 55928 followed by a zinc-rich primer at least 40 micron thick and 2 coats of two-component epoxy to 350 microns.)

411.6.2 Information to be Supplied with Pumps:

At a minimum, the Contractor shall submit with his proposal the following :

- Detailed description of pumps,
- Description of installation and any special arrangements, civil engineering works, grout, anchor bolts, etc., required for the installation,
- Operational curves of the pumps,
- Utilization instructions,
- Maintenance instructions,
- Recommended spare parts for 2 years of operation.

411.6.3 Submersible PumpType of Pump:

- The pumps shall be centrifugal, single stage, submersible.
- The pump shall be built of a monoblock, including the submersible motor.
- The pump shall be capable of handling sludge, having SS concentrations of up to 2%.
- Free passage : 80 mm
- The supply of the pump shall include all of the required operational components.
- The maximum pump speed shall not exceed 1,000 rpm. This is to prevent biological flocks breakup. Proposals that include motors with faster speed will not be accepted.

Conditions of Operation:

- Liquid temperature : 10–35 °C
- pH : 6–10
- Suspended solids : Up to 10,000 mg/l

Cables:

- 12 meters each of suitable cables for power and control.

Mechanical Seals:

- The pumps shall be equipped with mechanical seals of stationary and rotating rings, made of suitable materials, such as silicon carbide or silicon-silicon, that are suitable for the sewage liquid.

Shaft:

- The pump's shaft shall connect to the motor shaft via a mechanical coupling.

Bearings:

- Each pump shall be equipped with permanently lubricated bearings.
- The B-10 lifetime of the bearings shall be $\geq 100,000$ hours under normal operational conditions.

Operating Time:

- As mentioned above.
- When in manual operation, the pumps shall be capable of operating up to 10 start-stops per hour.

Installation:

- On a permanent elbow, anchored to the concrete floor of the pumping station via guiding pipes anchored to the walls, with a permanent discharge pipe made of SS316 seamless Schedule 40 pipe. All of the abovementioned items shall be included in the supply.
- Installation and removal of pumps shall be from above, with no need for a person to enter the chamber.
- SS316L chains for lowering and lifting of pumps shall also be supplied.

Motor:

- 3-phase, 400 V, 1,000 rpm.
- Totally submerged
- Service factor shall be 1.15.
- The motor shall be operated via a frequency converter.

Motor Protection:

- Water in motor:

- Electric probes shall indicate water presence in parts of the motor.
- Thermal protection:
 - Each phase of the motor shall contain a temperature monitor to indicate overheating.
 - Bearings shall also contain such monitors.

Materials of Construction:

- Housing : Cast iron, protected by an anti-corrosion paint
- Impellers : SS316, or better
- Shaft : SS316
- Bolts, nuts, etc. : SS316
- Guiding pipes : SS316
- Chain : SS316

411.6.4 Progressive cavity pump

Type of Pump :

- Pumps shall be of the PD, progressive cavity type, horizontally set, located in a dry chamber next to the equalization chamber.
- The suction of the pumps shall be from pipes protruding out of the wall.
- The discharge shall be into a pipe manifold, that leads the sludge to the centrifuges.
- The maximum pump speed shall no exceed 400 rpm.
- The pump shall be capable of handling liquor of up to 3% suspended solids that may contain some abrasive sand and grit.

Supply :

- The supply of the pumps shall include the following :
 - Pumps
 - Motors
 - Base plates
 - Couplings—mechanical or belts
 - Gear reducers, if necessary

Conditions of Operation:

- Liquid temperature : 10–40 °C
- pH : 6–10
- Suspended solids : Up to 2.0% of solids
- Ambient temperature : 5 °C to 35 °C
- Humidity : Up to 100%

Shaft:

- Preferably, the pump shaft shall connect to the gear / motor shaft via a mechanical coupling.

Bearings:

- Each pump shall be equipped with permanently lubricated bearings.
- The B-10 lifetime of the bearings shall be $\geq 100,000$ hours under normal operational conditions.

Operating Time:

- The pumps shall normally operate continuously, through a frequency converter.
- When in manual operation, the pumps shall be capable of operating up to 10 start-stops per hour.

Installation:

- On a concrete slab, in an outdoor shack.

Motor:

- The motor shall be a dry one and shall be assembled on the base plate of the pump.
- The connection between the pump and the motor can be via a mechanical coupling or belts.
- The motor shall be 3-phase, 400 V.
- The service factor shall be 1.15.
- The motor shall be operated via a frequency converter.

Motor Protection:

- Degree of protection: IP65
- Thermal protection:
 - Each phase of the motor shall contain a temperature monitor to indicate overheating.
 - Bearings shall also contain such monitors.

Guards:

- Guards shall be provided to protect plant personnel from rotating elements.
- The guards shall be easily removable for inspection and maintenance.

Materials of Construction:

- Housing : Cast iron, protected by an anticorrosion paint
- Stator : Buna N or equivalent hard rubber, to be suitable for the above mentioned sludge
- Rotor : SS316, or better
- Shaft : SS316
- Bolts, nuts, etc. : SS316

411.6.5 Submittals – for all pumps stations :

At a minimum, the Manufacturer shall submit with his proposal the following:

- Detailed description of pumps
- Description of installation, including any special arrangements that are required, such as civil engineering works, anchor bolts, etc.
- Operational curves of the pumps
- Utilization instructions
- Recommended spare parts for two years of operation

Testing**Shop Testing**

All of the abovementioned equipment shall be tested before shipment by the manufacturer. The shop testing shall be conducted in the presence of the Client's Representative, unless the Client provides written consent for the manufacturer to conduct the tests in the absence of the Client's Representative. All payments for the tests shall be at the sole expense of the Contractor.

Site Testing

Site performance testing shall be conducted for each pump in order to verify that the pump operates according to the requirements, and to confirm the wire to water efficiency of every pump throughout its complete range. The Contractor shall make good any deficiency in the performance, or replace the pump.

411.7 - Mechanical Horizontal Shaft Mixers

411.7.1 General :

This chapter deals with the supply, of mechanical horizontal - shaft mixers that shall be installed.

All mixers shall be capable of imparting a force of at least 10 watt per m³ mixed liquor and that will ensure a velocity in all parts of the tank between 0.3-0.5 m/s. The mixers shall be suitable for operation with an MLSS of up to 12,000 mg/l.

Vibrations that may have detrimental effects on the performance or strength of the equipment shall be avoided. A short description of the dynamic balancing procedures used by the manufacturer shall be provided. For an adequate protection of slurry flocs. The maximum tip speed of the mixer shall in no case exceeds 6.0 m/sec.

The units shall be furnished and installed with all necessary accessory equipment and auxiliaries, whether specifically mentioned in this chapter or not, and as required for an installation, incorporating the highest standards for the type of service specified. Supply shall include field technician representation during installation and startup of the units, and instruction of the Client's O&M personnel in the care, operation, and maintenance of all equipment.

Tools :

The Contractor shall furnish one set of all special tools required for normal maintenance of the equipment furnished under this chapter. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which the tools are intended.

Spare parts :

The Contractor shall furnish the manufacturer's recommended spare parts for two years of normal operation and maintenance of the equipment.

All spare parts shall be suitably packaged or boxed for long-term storage. Each part shall be clearly identified by part description, part number and other pertinent information or data.

Lifting mechanisms :

The Contractor shall furnish a lifting mechanism for each of the mixers.

This mechanism will be permanently connected to the side wall of the reactor.

The mechanism will be manually operated.

It will enable lifting / lowering the mixer and determining its height in the tank.

It will also enable to determine the operational angle of the mixer.

Maneuvering the mixer, by the lifting mechanism, shall be possible, while the tank is full of water.

General specifications of the mixers :

Each mixer shall be supplied as a complete unit, ready for installation and operation. The mixer unit shall consist of a marine impeller, a drive motor, a gear reducer assembly, base plate, anchor bolts, couplings, lifting mechanism, guiding rails, electrical cable etc.

The electric drive motor shall be controlled by a variable frequency controller.

Applicable Standards :

The mixer units shall comply with the following standards :

- American Bearing Manufacturers Association (ABMA)
- American Gear Manufacturers Association (AGMA)
 - AGMA 297.01 - Sound for Enclosed Helical, Herringbone, and Spiral Bevel Gear Drives
 - AGMA 390.03 - Gear Handbook Volume 1: Gear Classification, Materials, and Measuring Methods for Unassembled Gears
 - AGMA 420.04 - Enclosed Speed Reducers or Increases Using Spur, Helical, Herringbone, and Spiral Bevel Gears
 - AGMA 6010 - Standard for Spur, Helical, Herringbone, and Bevel Enclosed Drives

Where reference is made to one of the above standards, the revisions in effect at the time of proposal submission shall apply.

Materials of Construction :

- All submerged components, including shafting, impellers, studs, bolts, washers, and cap screws shall be made of Type 316 stainless steel. To prevent galling, nuts shall be made of stainless steel of lesser hardness than the bolts.
- Equipment anchor bolts and washers shall be made of Type 316 stainless steel. To prevent galling, nuts shall be made of stainless steel of lesser hardness than the bolts.
- All foundation anchor bolts, including nuts and washers, shall be furnished. All foundation anchor bolts shall be fabricated and installed in accordance with manufacturer's details, instructions, and recommendations.
- Equipment weighing over 50 kg shall be provided with lifting lugs.

Surface Preparation and Shop Prime Painting :

The mixers shall be prepared and shop primed as specified.

Marking of Equipment :

16-gauge brass or stainless steel nameplates shall be attached to each unit and motor. The nameplate shall indicate the following:

- Manufacturer's name
- Model number
- Speed
- Rated capacity
- All other pertinent data

411.7.2 Shafting and Impeller Assembly :

The impeller assembly shall be designed to produce, insofar as practical, completely balanced loads on the shaft.

The fabrication and assembly details shall permit accurate field assembly of the equipment and installation within the basins as shown in the Tender Drawings.

Structural members and connections shall be designed to withstand, within normal working stresses and deflections, all loads imposed on them by rotation of the assembly at maximum design speeds in water and in the dry, and also loads which may be superimposed during or subsequent to assembly, while the basins are empty.

The shaft shall be of the overhung design. Lower shaft straightness, rigid coupling squareness, and output shaft accuracy, shall give a maximum deflection at the lower end of the shaft, of 3 mm for every 3 meters of overhang, as measured when turning over by hand.

The impeller assembly shall be a marine type, bolted to a shaft hub assembly. The shaft shall be adequately designed for the maximum power output of the drive unit. The impeller shall be designed to impart a minimum of 20 W/m^3 to the water at maximum speed, without any tank baffling. The impeller assembly shall be securely keyed to a solid shaft. The impeller shaft shall be rigidly coupled to the reducer output shaft. The rigid shaft coupling shall be located above the support pedestal base for ease of servicing. Shafts shall be of sufficient diameter to operate without excessive vibration over the entire speed range. No underwater bearings shall be permitted.

411.7.3 Motors

- Voltage: 380 V
- 3-phase
- 50 Hz
- 1,500 rpm
- Squirrel cage
- Service factor: 1.15
- Motors shall be furnished with winding temperature detectors.
- Motors shall be operated by frequency converters.

411.7.4 Gears

Gear reducers shall be a combination of helical and spiral bevel gearing in a housing of either high quality close-grained cast iron or stress-relieved and reinforced fabricated steel. The reducer output shaft shall be directly connected to impeller shaft. The gear reducer shall be constructed in accordance with AGMA Standard 420.04. The reducer shall be suitable for AGMA Class II 24-hour continuous service under moderate shock conditions. Each bearing incorporated within the reducer, shall be of the anti-friction type having a minimum B-10 lifetime of 100,000 hours based on the

latest AFBMA standards when operating continuously at the maximum rated motor horsepower and speed. All of the gearing shall be contained within a single housing and shall be lubricated by a common oil bath.

Gear reducer bearings shall be oil lubricated by emersion in an oil bath, or by splash lubrication accomplished by means of gears or a slinger rotating on a horizontal shaft in an oil bath to ensure the positive displacement of oil to lubricate all critical bearings. Oil pumps shall not be allowed. A dry well seal shall be provided to prevent oil leakage down the output shaft. A dip stick shall be furnished to measure the oil level in the reducer housing. Sightglasses, or other visible means to measure oil levels, shall not be allowed. Reducer output shaft bearings (both solid and hollow shaft types) shall be grease lubricated or permanently lubricated. All oil fill and drain lines and grease fittings shall be located so as to be easily accessible.

The full load operating noise level of the gear reducer shall not exceed 80 dBA at a distance of 1 meter from any part of the drive assembly.

The gear reducer and motor assembly shall be mounted on either a cast iron or fabricated steel pedestal support with a flanged baseplate suitable for mounting on a flange provided in the basin top as shown in the Tender Drawings. The equipment manufacturer shall furnish the pedestal support. The pedestal support shall be

designed for all loads appropriate for the seismic zone in which this project is located.

The reducer output shaft shall be connected to the mixer shaft by means of a rigid carbon steel flanged coupling. The coupling shall be located above the drive assembly baseplate and the mounting deck.

411.7.5 Submittals

At a minimum, the Contractor shall submit with his proposal the following:

- Descriptive literature, bulletins, catalog cuts, and drawings of the equipment
- Complete bill of materials for the equipment
- Spare parts list
- Description of surface preparation and shop prime painting, including certification that the paint to be used to shop prime the equipment is compatible with the finish coat paint to be applied to the equipment
- The weight of each component—motor, gearbox, shafting, and impeller
- Complete motor data and schematic wiring diagrams. Submittal information shall include detailed information indicating wiring connection points for all external devices and controls as called for herein
- Design calculations demonstrating that the equipment process design requirements are met, with design loads including vertical download, torque, and bending moment imposed by the impellor on the support system.
- O&M data

Before ordering any equipment, the Contractor shall submit to the Client's Representative shop drawings and particulars for the equipment being furnished.

411.7.6 - Testing

Shop Testing

The mixers shall be given the manufacturer's standard quality control inspections and tests to ensure quality of materials used in the manufacture of the units and workmanship conform to the specified requirements and highest industry practice, the units operate properly, and the units have been adequately and correctly prepared for shipment, long-term site storage and initial operation.

Delivery, Storage, and Handling:

Factory assembled parts and components, shall not be disassembled for shipment unless permission is received in writing from the Client's Representative.

Finished iron and steel surfaces that are not painted shall be properly protected to prevent rust and corrosion.

All equipment parts, shall be properly protected so that no damage or deterioration will occur during shipment or prolonged delay from the time of shipment until installation is completed and the equipment is ready for operation.

All equipment and parts shall be properly protected against damage and deterioration during prolonged storage at the site.

Field Testing

Field Installation

Field installation of the units shall be supervised by a manufacturer's field technician, knowledgeable in the proper installation of the units. A minimum of ten days of field time shall be provided by the manufacturer to supervise the installation of the mixers.

Field Testing

After the units have been completely installed and the installation approved by the manufacturer's field technician, and after acceptance by the Client's Representative, the units are to be tested under the supervision of the manufacturer's field technician. The units shall be field-tested to verify that the performance of all system components conform to the specification and design requirements and is in proper operating condition, free from vibration and other defects or faults of any kind. The Contractor shall furnish all labor and incidentals required to conduct such tests and to correct to the full satisfaction of the Client's Representative any and all defects or deficiencies noted.

A seven-day continuous operation period for the each unit shall be required before acceptance.

In the event any item fails to meet the requirements specified above, the necessary changes shall be made and the item retested. If the item remains unable to meet the specified requirements to the satisfaction of the Client's Representative, the item shall be removed and replaced with satisfactory item at no cost to the Client.

411.8 Thickening System

411.8.1 Scope

The supplier shall supply a Thickening System that will include one of the possibilities described below on sub clause 411.8.2 and 411.8.3 and 411.8.4.

The major equipment items to be supplied shall be composed of the following: two (2) mechanicals thickener fully enclosed; one (1) polymer preparation, storage and supply system; one (1) discharge hopper; two (2) waste sludge feed pumps units (Positive displacement pump); two (2) Thickened Sludge Pumping Units (Positive displacement pump); and one (1) System Control Panel.

411.8.2 Performance Requirements

The thickener supplied shall be capable of thickening waste activated sludge from a feed sludge minimum solids concentration of around 0.6%÷1.5% to a thickened sludge solids concentration of no less than 5% with a solids capture rate of at least 95%.

411.8.3 Gravity Belt Thickener (GBT).

Main Structural Frame.

The main structural frame shall be of welded and/or bolted construction, designed to accommodate all operating and static loads without deformation, or excessive deflection or vibration during shipping, installation and actual operation.

It is preferred that the frame be made of stainless steel. Frames made of carbon steel will be hot-dip galvanized and painted. Carbon steel frames protected by any other method will not be considered.

It is preferred that frame members be of tubular (or similarly closed) cross-section. Channel frame members will be considered provided that open sides of the channels are oriented away from the sludge stream. "I" frame members will not be considered. The structural frame shall be designed to take all the horizontal loads imposed by the GBT without external support from the GBT Building, and all loads imposed on the building shall be vertical.

The size of the effective gravity area will be taken into account in the comparison of competing bids.

To contain aerosols and odors, the GBT shall be encased in minimum 316 stainless steel enclosures (tops and sides) and shall include preparation for connection to plant's odor neutralization system.

Odors from the GBT will be extracted and treated in an odor neutralization system.

The top enclosures shall be equipped with easily-opened lift-up doors to enable observation of the gravity deck and servicing of the plows. The side enclosures shall be equipped with easily-opened hatches to enable observation of interior components. It is essential that the top and side enclosures not enclose or obstruct access to any of the system components requiring regular servicing or adjustment, (such as bearings, drive assembly, tracking and tensioning equipment, spray assembly handwheels, etc.).

All shafts penetrating the side enclosures shall be suitably sealed. The top enclosures shall each be equipped with at least two outlet ports suitable for connection to extract ductwork.

Thickening system shall be designed for safe use in an explosive atmosphere.

In-line Mixer and Sludge Distribution Tank

The GBT shall be equipped with an in-line static mixing unit which shall allow for variation by the operator of the turbulence and mixing energy. The GBT shall also be equipped with a (316) stainless steel Sludge Distribution Tank, of sufficient volume to allow for the continued mixing of the feed sludge with the polymer solution. The tank shall discharge the feed sludge and polymer mixture evenly across the entire width of the gravity drainage belt. An adjustable leveling dam shall be provided on the GBT to roll the sludge and enhance its even distribution across the belt. The tank shall be equipped with a slow-speed mechanical agitator (all parts minimum 316 SS).

Gravity Drainage Section

The conditioned sludge shall be fed to a horizontal gravity drainage section designed to achieve maximum free water removal through a drainage belt. This section shall be equipped with plows for the even distribution and dispersion of the sludge and the effective removal of the ponded water. The plows shall be individually suspended (using a weighted or spring-loaded mechanism) so that each plow can remain in contact with the belt over its entire life and so that obstructions encountered by a single plow do not affect other plows in the same row. Plows shall be made of UHMW polyethylene to prevent abrasion of the belt. Each individual row of plows shall be capable of being readily rotated out of the sludge flow for servicing. Suitable fencing to prevent splashing shall also be provided. Stainless steel skirts (appropriately sealed) shall prevent water leakage from the machine.

A detention device (discharge dam) or similar device shall be provided on the GBT for rolling the sludge just prior to cake discharge. The angle of the discharge dam shall be readily adjustable.

The filtration belt shall be of the split type (not continuous), woven from monofilament polyester strands. The belt shall incorporate a 316 stainless steel mechanical (clipper) seam with a plastic protective coating; the seam shall allow for simple belt replacement. One belt and one spare belt shall be included in the supply of the GBT. Each belt shall be guaranteed by the Tenderer for a minimum life under normal operating conditions of 3000 hours.

The supports under the drainage belt shall be designed and oriented for effective support of the belt over its route of travel. The distance between adjacent supports shall be noted by the Tenderer with his bid.

Thickened sludge shall be removed from the drainage belt by a doctor blade. The doctor blade shall be made of UHMW, backed by a 316 stainless steel reinforcing plate. The tension of the blade against the belt shall be easily adjustable via a weighting assembly or a stainless steel coil spring. The doctor blade shall be easily removable from its operating position for cleaning or maintenance and shall be reversible. A spare doctor blade shall also be included in the supply of the GBT. Rollers and Bearings.

The GBT drive roller shall be rubber-coated (minimum 3/8" coating) carbon steel for maximum traction. For reasons of corrosion protection, it is preferred that the other GBT rollers be made of 316SS, but rubber-coated (minimum 1/4" coating) carbon steel rollers will be considered. At rated belt tension, rollers shall be designed to deflect no more than 1 mm at midspan. Frame design shall be such that all rollers may be removed from the side of the GBT without the need for the disassembly of the frame or the movement of other rollers.

Bearings shall be of the pillow-block type, with split cast-iron housings. Bearings shall be individually accessible and shall have a minimum B-10 life of 100,000 hours at the design belt speed and tension. Bearings shall be grease lubricated (permanently lubricated bearings shall be unacceptable). Bearings shall be double-sealed against ingress of foreign matter. Bearings and service points shall be located outside the enclosed area of the GBT. Similar size and type grease nipples shall be employed for all System components requiring greasing.

Belt Drive Assembly

The GBT shall be driven by an electric motor, IP55 protected. The belt drive speed shall be infinitely variable over a range of 5 to 15 meters per minute. Control of the speed shall be effected by frequency converters to be included in the supply of the GBT SCP below. Variable-speed hydraulic motor assemblies will also be considered. Tracking and Tensioning Tracking: Belt positioning shall be continuously and automatically monitored by sensing elements in contact with the belt edges. Belt misalignment shall be corrected by tracking rolls actuated by hydraulic or electro-mechanical cylinders. Belt override sensors shall be installed to indicate extreme belt misalignment and shut down the entire GBT System, sounding an alarm. Belt break shall also be automatically sensed and result in the shutdown of the entire GBT System and the sounding of an alarm.

Tensioning: Belts shall be provided with an automatic, mechanical tensioning system to ensure proper belt tension.

Hydraulic Power Unit

If the main drive or the tracking system is hydraulically powered, the requisite hydraulic power unit shall be included in the supply of the GBT. The GBT shall be equipped with its own hydraulic power unit.

Hydraulic power units supplied shall be complete units that include all related and auxiliary equipment and accessories, including the reservoir, motor, pump, filter, directional control valves, pressure reducing valves, flow control valves, check valves, pressure gauge, gauge panel, level switch, filter indicator, fittings and devices.

All required hydraulic interconnecting piping (including all hydraulic fittings and between the hydraulic power unit and the GBT) shall also be included in the supply of the hydraulic power unit.

Belt Washing System

The supply of GBT shall include the supply of two (2) Wash water Pumping Units and one (1) belt wash stations.

Wash water Pumping Units

The Contractor shall supply two (2) booster washwater pumping units for washing the belt of the GBT. Specified flow rate and pressure to be as per GBT manufacturer's requirements.

the pump shall be active with the second unit in reserve. In the event the active pump fail or removed from service, the second pump shall be used in place of the affected pump. The entry into service of the reserve pump need not be automatic (appropriate valves will be opened and closed manually), but the GBT SCP shall be equipped with all necessary controls and logic so that the reserve pump is treated as the appropriate GBT active pump for all start-up, running and shut-down operations.

Belt Wash Station.

Following cake discharge, the belt shall be continuously washed by low-volume, stainless steel, non-clogging, easily-cleaned, easily-accessed, easily-replaceable spray nozzles. The nozzles shall be self-cleaning by way of stainless steel brushes contained

within the spray heads. Manual operation of the brushes shall be effected by means of an external handwheel. A separate belt wash station shall be provided for the GBT belt. The belt wash pipe and nozzle (header) shall be housed in a stainless steel enclosure. The shower assembly shall include a strainer to allow removal of particles that might otherwise enter the nozzles. A shut-off valve for the shower assembly, a 0-160 psi pressure gauge, a pressure switch to sense loss of pressure and a controlling solenoid valve shall also be provided for installation in the washwater supply piping. The pressure switch shall both shut down the washwater supply and shall transmit the low-pressure condition to the GBT SCP.

Filtrate and Washwater Collection

Drainage (including all required pans, collectors and pipes) from the gravity dewatering section and the belt wash station shall be provided to collect and transport filtrate and wash down water to the floor drainage system. All drainage components shall be 316 stainless steel, minimum 16 gauge (1.5 mm), shall be connected to the GBT and shall discharge to a floor drainage system directly below the units. The piping to the floor drainage system shall be 316 stainless steel or impact resistant plastic and shall extend to no more than 10 cm (4") above the top of the trench into which it drains. Multiple drain pipes shall be permitted.

The drainage system shall ensure that no feed sludge or filtrate escapes onto the floor or onto any component of the GBT other than the drainage system supplied for that purpose. Specifically, Tenderers must show with their bids that, in the event of any process or mechanical upset, including but not limited to the feed sludge exceeding the hydraulic capacity of the GBT, the excess feed sludge is conveyed to the drainage system without ever contacting the GBT frame or the inner surface of the GBT belt.

Emergency Shut Down

An emergency shut down cable shall be provided and located on each side of the GBT.

The cable shall extend the full length of the press and be accessible from the floor or a platform. Actuation of the pull cable shall stop the GBT and de-energize all associated dewatering equipment. The cable switch shall be maintained in the stop position until manually reset.

Hardware and Materials

All hardware (bolts, nuts, clips, screws, fasteners, etc.) shall be minimum 316 stainless steel. Non-ferrous galvanized and stainless steel items shall remain unfinished. Only non-corrodible materials shall be used for components in direct contact with sludge and flocculant.

411.8.4 Drum Thickener

The contractor shall supply a mechanical drum-thickener of the "Rotary-Drum" type. The thickener will work constantly as long as sludge is fed into it.

Main Structural Frame

The rotating drum will be made of stainless steel and will hold the screening material.

Screening Material

Thickening will be done by a screening drum made of stainless-steel 316 that will be enclosed in an outer stainless steel drum. Screening holes will be no more than 3 mm'.

Gravity Drainage Section

The drum will include a gravity drainage system for both filtrate and wash water. It will be clearly shown where and how the drainage system works.

Drum Washing System

The supply of Drum Thickener under Sub-clause 2.3 shall include the supply of two (2) Wash water Pumping Units and one (1) belt wash stations.

Bearings

Bearings shall be of the pillow-block type, with split cast-iron housings. Bearings shall be individually accessible and shall have a minimum B-10 life of 100,000 hours at the design belt speed and tension. Bearings shall be grease lubricated (permanently lubricated bearings shall be unacceptable). Bearings shall be double-sealed against ingress of foreign matter. Bearings and service points shall be located outside the enclosed area of the thickener. Similar size and type grease nipples shall be employed for all System components requiring greasing.

Drum Drive Assembly

The drum will be driven by geared motor. The motor will be of changing speed by means of a frequency transformer to enable to reduce sludge inflow without harming thickening performance. Drum performance will not be less than 1.1 kW and of variable speed.

Drum and Screen Washing System

The thickener will include a cleaning/washing system. Wash water will flow in the counter direction to the filtrate to ensure efficient cleaning. The system will work at a pressure of no less than 30 bar and duration of about 30% of screening time. The cleaning system will include a solenoid system and may have additional brush cleaning.

Brushes alone will not be acceptable. The system will include all piping, valves and accessories needed. All drainage components shall be 316 stainless steel.

Emergency Shut Down

Thickening system will include an emergency shut down switch.

Hardware and Materials

All hardware (bolts, nuts, clips, screws, fasteners, etc.) shall be minimum 316 stainless steel. Non-ferrous galvanized and stainless steel items shall remain unfinished. Only non-corrodible materials shall be used for components in direct contact with sludge and flocculent.

Drum Thickener system shall be designed for safe use in an explosive atmosphere. To contain aerosols and odors, the Drum Thickener shall be encased in minimum 316 stainless steel enclosures (tops and sides) and shall include preparation for connection to plant's odor neutralization system .

Odors from the Drum Thickener will be extracted and treated in an odor neutralization system, to be supplied and erected by the others.

411.8.5 Thickener System Control Panel (SCP)

The Contractor shall supply one thickener System Control Panel.

The thickener SCP shall be equipped with Auto Start and Auto Stop buttons. When the Auto start button is pushed, a programmed inspection shall check the readiness to operate of the following:

- Thickener - including the hydraulic power unit, electric drive unit (if applicable), and any other equipment supplied.
- Polymer Preparation and Supply System (System shall register "ready" only when a pre-designated minimum amount of stored polymer solution is ready to be pumped, and the pumping/delivery system is operational).

- At least one of the Washwater Pumping Units.
- Sufficient level of sludge in the Holding Tank, based on measurement from ultrasonic liquid level gauge (said gauge to be supplied under Division 2 but connected to the thickener SCP).

If the inspection confirms that the specified components are ready to operate, the following start-up sequence shall be executed:

1. Start pumps for thickened sludge
2. Start thickener
3. Start Pumping Units
4. Programmed time delay (delay time shall be adjustable from Central Computer).
5. Start Polymer Preparation and Supply System (This step shall begin the pumping of the pre-mixed polymer solution).
6. Start "was" Pumps

The above Auto Start sequence shall be activated automatically from the SCP when the sludge level in the "was" pumping station rises above a pre-designated level. The "was" Pumps shall be prevented from starting, and, if operating, shall be stopped when the thickener Auto Stop or Emergency Stop sequences are activated.

When the Auto Stop button is depressed, the following shut-down sequence shall be executed:

1. Stop "was" pumps
2. Stop pumping of polymer solution
3. Programmed time delay (delay time shall be adjustable from SPLC)
4. Stop thickener
5. Stop Washwater Pumping Unit
6. Programmed time delay (delay time shall be adjustable from SPLC)
7. Stop pumps for thickened sludge

Emergency Stop

The thickener System shall be equipped with an Emergency Stop sequence which shall be activated when the thickener SCP emergency stop button is depressed, when the SPLC has failed, when the thickener emergency shut-down cable is activated, when the washwater pressure drops below a pre-designated value, when belt break or excessive belt misalignment has occurred (for GBT), or upon the failure of any of the thickener System components which were part of the programmed "inspection check" above. (The failure of both Washwater Pumping Units, not just one, shall be necessary for this purpose). The activation of the thickener Emergency Stop sequence shall shut-down all components of the thickener System immediately, and activate a visual/audio alarm.

Setting the selector switch of the thickener SCP motor (including the PPSS) to Manual shall remove that component from the above Auto Start and Auto Stop sequences, but not from the Emergency Stop sequence.

System Failure

System failure for the thickener shall be defined as occurring when the Emergency stop sequence is activated. If System Failure occurs, the thickener SCP shall, via a dry contact, transmit a failure alert to the CCP, where a visual/audio alarm will be activated.

Controls

The thickener SCP shall be equipped with the following controls and control functions:

- Controls for the adjustment of GBT or Drum Thickener speed, and dewatering pressure.
- Controls for the automatic rotation of the Washwater Pumping Units (on daily asis) and emergency rotation into service of non-active pump.
- controls for the automatic rotation of the "was" Pumps (on a daily basis) and emergency rotation into service of non-active pump.
- control of thickener screw pumps for thickened sludge.
- control of Polymer Preparation and Supply System
- Other controls and control functions.

Displays

The thickener SCP shall be equipped with the following displays:

- Digital indicator to display the feed sludge flow rate, in cubic meters and tenths of cubic meters per hour, as measured by flow meter to be supplied by the Division 2 Contractor. Flow meter to be connected to thickener SCP. Display to include totalizer.
- Digital indicator to display the solids concentration, in percent and tenths of percent, of the thickener feed sludge, as measured by solids concentration gauge to be supplied by the Division 2 Contractor. Gauge to be connected to thickener SCP.
- Display of liquid level in 'thickener Feed Sludge Storage Tank', in meters and tenths of meters, as measured by ultrasonic liquid level gauge to be supplied by the Division 2 Contractor. Gauge to be connected to thickener SCP.
- Display of PPSS solution concentration and dosage rate settings, and the measured polymer flow rate
- Totalizer for polymer flow.
- Other displays, above and other parts of this Clause.

411.9 - Decanter Centrifuge System

411.9.1 - Scope

The decanter shall consist of a solid horizontal bowl and helical scroll conveyor, with a countercurrent process flow configuration. The centrifuge should be designed and built to operate continuously and at full speed.

Process seals and O-rings shall be made of nitrile rubber or approved material. The centrifuge shall be capable of dewatering dry solids of waste activated sludge to a cake solids concentration of at least 20%, with a solids capture rate of at least 95%. The solids concentration of the feed sludge will normally be 2%-4%.

The Decanter Centrifuge System shall comprise decanter centrifuge, Thickend Sludge pumping units, polymer preparation & dosing system, screw conveyors, electrical panel and a System Control Panel, all as specified below.

The Decanter Centrifuge System is designed to operate 5 days per week at maximum 9 hour a shift.

To contain aerosols and odors, the Decanter Centrifuge shall include preparation for connection to plant's odor neutralization system .

Odors from the Decanter Centrifuge will be extracted and treated in an odor neutralization system.

411.9.2 - Decanter Centrifuge

The supplier shall supply decanter centrifuge which shall satisfy the specifications in this Clause.

The decanter centrifuge shall be constructed as package units, consisting of but not limited to the components described below. The decanter centrifuge shall be of the horizontal, solid bowl, scroll type. Both countercurrent-flow and co-current-flow designs will be considered. The wetted parts of the centrifuges shall be constructed of 316 stainless steel or better.

The centrifuge shall be dynamically balanced to minimize vibration. The rotating assembly design shall be such that the lowest natural frequency of any component shall result at least 30% of the design speed of the centrifuge.

Frame

The main frame parts shall be made of mild steel box beams connected with cross beams where the main bearings are placed.

The main drive motor shall be either flange mounted on an adjustable plate or placed on a motor shelf and fitted with vibration dampers. The drive motor is located either between the two legs at the solids discharge and of the decanter or inline to one side at the solids discharge end. The back drive shall be placed on the placed on the frame in line with the gearbox.

The frame shall be mounted on rubber type vibration damper isolators.

The frame shall be coated with special protective coating.

Casing

The lower part of the casing shall either be an integral part of the frame or a separate fabrication. The liquid outlet and the solids outlet shall be located between the two box beams. The compartment between the outlets the casing shall consist of a plate slopping towards the liquid end. The casing shall be either of stainless steel fabrication or carbon steel with product discharge area clad by AISI 316 stainless steel. The cover shall be made of stainless steel with a nitrile rubber gasket seal. The baffle in the casing shall prevent entrance of liquid solids into the central compartment of the casing.

Process Connections

The feed tube shall be fabricated from AISI 316 stainless steel. Feed connection shall be a hose connection with optional flex connection and flange adapter. Polymer addition at the feed tube shall be possible.

Cake and centrate discharge shall be rectangular bolted type.

Main drive

The main drive motor is shall be high efficiency 4 pole motor either flanged or foot mounted on to a motor mounting assembly ababling simple belt tensioning. Power is transmitted from the motor pulley to the bowl pulley via V-belts. The manufacturer has to be feed the client with drawings showing the foundation required for the decanter.

Back drive Systems

The centrifuges shall be equipped with back drive systems to permit the automatic adjustment of the differential speed (between the scroll conveyor and the centrifuge bowl) during centrifuge operation, thus optimizing the solids residence time in the centrifuges and the cake solids contact.

Back drive systems shall either be of the eddy current brake type or the hydraulic type.

The back drive mounting on the decanter frame shall be on-line, coupled to the gearbox viz a flexible coupling. It is completely electric in operation with no hydraulic power transmission, consisting of an inverter driven high efficiency motor.

Belt Guards and Gearbox Covers

Guards and covers shall be of painted carbon steel or fiberglass.

411.9.3 - AssemblyBowl Assembly

The bowl assembly shall be manufactured from 316 SS, material or better. The decanter bowl shall consist of a cylindrical section plus a conical beach extension.

The choice of angle of the cylindrical/conical intersection is made according to process requirements. The bowl shall be manufactures from centrifugally cast stainless steel with a correction resistance equivalent to that of AISI 316. Prior to final machining, all surfaces shall be examined for cracks, shrinkage, porosity or other defects by means of liquid dye penetrant test.

The bowl shall be mounted on rolling element bearing with a minimum rating according to L10AAH of 100,000 hours when balanced and assembled to the manufacturer's specification.

Bearings shall be lubricated by grease or by forced lube oil systems. The liquid level shall be controlled by plate dams located at the large diameter end of the bowl where the liquid is discharged. The plate dams shall be retained with plated and sealed with nitrile rubber gaskets.

Conveyor Assembly

The conveyor shall be fabricated from AISI 316 SS.

The conveyor flights shall have a thickness and material grade (AISI 316 or Duplex) making the fabrication rigid enough to transmit the high loads necessary to convey high dry solids cake from the bowl.

The conveyor shall be concentrically suspended within the centrifuge bowl by low friction rolling element bearing, lubricated from external fittings that are accessible for necessary maintenance.

The feed zone shall be of a high capacity design with field replaceable hard surface wear protection. The conveyor shall be equipped with a baffle disk, which gives the possibility of exerting an enhanced hydraulic pressure on the dewatered cake and ensures that all the solids discharged will be exposed to the full acceleration available within the decanter centrifuge.

Optional low maintenance greased for life conveyor bearing shall be available as separate conveyor options.

Gearbox

The gearbox shall be a suitably sized multi-stage planetary gear reducer unit, which provides the torque necessary to maintain the differential speed between the centrifuge bowl and conveyor whilst discharging a high shear strength low moisture cake. The gear unit shall have a torque capacity depending on size and application.

The gear box shall be the direct drive type rather than the breaking type, thereby eliminating the need for power regeneration from the backdrive.

Gears shall meet AGMA Class 10 and 11 requirements and the sun and planetary gears shall be case hardened and ground. Lubrication shall be self-contained, using high performance synthetic gear oil. The individual stages of the gearbox and the body shall be balanced as components prior to assembly.

Scrolls

The centrifuges shall be equipped with helix, screw-type scroll conveyors to be installed concentrically within the bowls. The scrolls shall be designed to convey sludge solids without clogging and with minimal disturbance to the pool. The conveyor speeds shall be controlled by the back drive assembly. The conveyors themselves shall consist of a central core or hub with a feed compartment and feed ports.

The scrolls shall be constructed of 316 stainless steel.

Wear surfaces

The design of the centrifuges shall include, due concern for the abrasive wear on the tips and leading edges of the scroll conveyors, feed and outlet ports and solids discharge ends of the bowls and bowl housings. All portions of the machines that are affected by abrasive action shall be protected by easily replaceable sintered tungsten carbide tiles. All such wear surfaces shall be guaranteed for at least 15,000 hours of operation between rebuilds and/or replacements.

Bearings

Main bearings shall be spherical roller bearings, with an L-10H life of at least 100,000 hours, and housed in pillow blocks split on the center line to permit easy servicing. Main bearings tube lubricated by an external circulating oil system or by grease. Conveyor bearings shall be grease-lubricated with an L-10H life of at least 100,000 hours.

Thrust bearings shall be grease-lubricated with an L-10H life of at least 100,000 hours.

Feed Zones

The sludge shall be introduced into the feed zones via 316 stainless steel pipes. The feed compartments shall have abrasion-protected accelerators.

The centrifuges shall be equipped with backdrive systems to permit the automatic adjustment of the differential speed (between the scroll conveyor and the centrifuge bowl) during centrifuge operation, thus optimizing the solids residence time in the centrifuges and the cake solids content.

Back drive systems shall either be of the eddy current brake type or the hydraulic type.

Eddy Current Brake Back drive System

Back drive systems using an eddy current brake shall include a planetary (or cyclo) gearbox, with the eddy current brake controlling the differential speed and torque exerted on the pinion shaft of the gearbox. The differential speed shall be automatically and continuously adjusted based on the monitored load on the conveyor.

The Decanter Centrifuge System Control Panel shall be equipped with all controls necessary for this purpose, as required hereinafter and in the Electrical Specifications. The bowl speed, the conveyor speed (and, hence, the differential speed) and the torque exerted on the conveyor shall be transmitted continuously to the Decanter Centrifuge System Control Panel.

The gearbox shall be lubricated by an oil bath system, including cooling system if required.

Hydraulic Back drive System

Back drive systems of the hydraulic type shall automatically maintain the optimum torque input to the scroll. The differential speed shall be automatically adjusted based on the reactive torque at the scroll shaft, thus optimizing the amount of time the cake solids are subjected to centrifugal force. Torque shall be measured as a function of the hydraulic pressure.

Each back drive system shall include a hydraulic pump drive unit and a hydraulic motor. The hydraulic pump drive unit shall include an oil reservoir (capacity of 3X maximum pumping rate) of heavy gauge steel construction. The reservoir shall include an oil temperature indicator, oil level indicator, drain plug, filler and breather cap, suction strainer, pressure filter and all other related and auxiliary equipment. The contractor shall define at least three names of Israeli workshops that are able to maintain the hydraulic pump drive.

The pump drive unit shall also include the hydraulic pump, electric motor, motorpump coupling, and heat exchanger. The drive unit shall be separately floor-mounted on vibration isolators. The heat exchanger shall be equipped with an oil bypass check valve to maintain oil flow in the event of heat exchanger clogging. The hydraulic motor, mounted on the

centrifuge, shall be of the high torque, low-differential-speed, radial-piston type, modified for high speed rotation.

Controls at the Decanter Centrifuge System Control Panel shall include adjustable set points for differential rpm, torque and response rate (rate of change of scroll differential speed). The hydraulic pressure in the back drive system, as transmitted by a pressure transducer mounted on the hydraulic pump outlet, shall be indicated digitally.

The hydraulic back drive system shall include pressure gauges and switches, flow meters, hydraulic accumulators, pressure relief valves and all required hydraulic tubing, piping and fittings.

Main Drives

The main centrifuge motors shall be of high thermal capacity design, horizontal squirrel-cage induction type, non-hydroscopic, Class F, premium insulation, totally enclosed, fan cooled, with a 1.15 service factor. The motors shall operate through Vbelt and pulley arrangements. The motors shall be designed for (reduced voltage) soft starting to avoid high in-rush currents and shall be mounted on a separate pad independent of the centrifuge bases to minimize the effects of vibration.

Noise Levels

The centrifuges shall be designed so that the noise level at 1 meter shall not exceed 85 DB. Isolation System

The centrifuge shall be mounted on vibration isolators. The isolators shall provide maximum efficiency. The isolators shall be erected between the machine base and its foundation.

All connections to the centrifuge shall be flexible, mostly applicable to the functioning of the centrifuge including the Digested Sludge piping, cooling water piping, polymer piping, cooling water piping, centrate discharge and solids discharge. All required flexible connections to the centrifuge shall be included in the supply of the centrifuges.

Vibration meter and Switches

The centrifuges shall be supplied with factory pre-set vibration meter and vibration switches with separate contacts, for alarm and for shutdown, to the Decanter Centrifuge SCP.

The manufacture is to define extreme levels of the amplitude : the frequency of vibrations and the vibration meter and shall measure both data simultaneously. The manufacturer shall submit instructions how to deal with failures when the values of vibration higher then permitted.

Discharge Pipework

The supply of the centrifuge shall include the supply of discharge pipework and collectors for both the dewatered cake and the centrate.

The dewatered cake shall be conveyed to the Screw Conveyor System. The centrate shall be conveyed to the floor drainage system. The discharge outlet to drainage will be flanged type.

Discharge pipework of both: dewatered caused centrate shall be 316 stainless steel, connected to the centrifuges with flexible couplings.

Flushing equipment

All necessary controls, equipment and accessories needed for flushing the centrifuge with water or plant effluent shall be included in the supply of the centrifuge. The water flush system shall be automatically and manually interlocked with the centrifuges' Auto Start and Auto Stop sequences, so that the centrifuge is flushed after every shutdown.

Main Bearing Lubrication unit

An external lube unit is only required on those large size decanters where the main bearings are lubricated by oil spray or bath. It shall consist of a lubrication panel and the piping assembly.

The system shall provide a flow of lubricating oil under pressure and include an oil reservoir, pumps, filters and strainers as well as temperature, pressure and flow instrumentation to automatically monitor and ensure the current operation. Cooling shall be by either air or water heat exchanger depending upon the environmental conditions.

411.9.4 - ProtectionConveyor hard surfacing

The conveyor flights shall be protected with flame sprayed hard surfacing of the flights from the solids discharged end to past the feed zone. Maximum volume loss the hard surfacing shall be maximum 20 mm³ millimeters when tested in accordance with ASTM.

If the application so demands, an enhanced wear protected conveyor shall be optionally available with sintered tungsten carbide tiles on the part of the conveyor exposed for abrasive wear, from solids discharge end to approximate 2 flights past the feed zone.

Maximum volume loss of the tiles is three (3) cubic millimeters when tested in accordance with ASTM G-65, Produce A. The remaining conveyor flights have a flame sprayed hard surfacing of the flights.

Bowl Shell Wear Protection

The bowl shall have stainless steel strips to secure proper solids conveying and to protect against abrasion. The solids discharge area shall be protected with field replaceable stellite wear bushings or tungsten carbide saddles.

Casing Protection

The solids outlet area of the casing shall be erosion protected by a stainless steel wear liner.

Paint

Stainless steel surfaces shall not be painted. All fabricated steel and cast iron surfaces of the centrifuges shall be hot-dipped galvanized.

Balancing

During manufacture of the bowl, the conveyor and the gearbox shall be balanced individually before assembly. The components are balanced to a quality level of 2.5 according to the ISO1940 standard.

Inspection

The general shop vibration acceptance level shall be maximum 6[mm/s r.m.s] measured at the main bearings. A maximum vibration level of 8[mm/s r.m.s] can be accepted on some decanter variants but only if a quality of 2.5 according to ISO1940 is fulfilled for each main component.

It is accepted that these are clean machine factory acceptance tests and operating vibration levels during normal processing may be higher.

Documentation

Instruction manuals

The instruction manuals for decanters shall be provided in a number of volumes and be available in the main languages.

Installation data. This volume shall contain general information and recommendations. It also includes a dimensioned drawing and wiring diagrams.

Operator's manual. This volume shall contain operation and service information as well as instructions for disassembly and reassembly.

Spare parts (SP). This volume shall contain the spare parts list whereby almost all parts of the decanter can be identified by their part number.

Operator Viewing

The design of the centrifuge shall permit the operator to view the sludge feed, sludge cake and centrate.

Maintenance Equipment

The supply of the centrifuge shall include the supply of such specialized dollies or lifters (specifically including the lifting yokes for the bowls and scroll conveyors) as are necessary to support centrifuge parts during disassembly, reassembly, removal from the centrifuge, maintenance or moving of these parts.

Specialist tool shall be provided with each decanter where necessary to undertake normal maintenance such as wear inspection, lubrication and drive belt tensioning.

Universal tools

Shall consist of mainly spanners and Allen keys which should already be available in an adequately equipped workshop.

Special tools

Pulleys and other tools necessary for replacement of bearings and seals.

Lifting tools

Tools for the safe lifting of bowl, conveyor and cover.

Intermediate service kit for wear inspection Major Service kit is to be supplied 72 hours before the guarantee expires.

Spare parts

The manufacturer shall submit a written commitment to supply spare parts up to 10 years after the halt of manufacturing the model of centrifuge that is supplied.

411.9.5 - Decanter Centrifuge System Control Panel (SCP)

The Contractor shall supply one Decanter Centrifuge System Control Panel and one electrical panel.

The decanter controller shall provide a real time graphical display of the following operational parameters:

- Bowl speed
- Conveyor Torque
- Conveyor Differential
- Operating Mode
- Operating Set point

Simple intuitive set point adjustment via a touch screen shall the operator to adjust the operating settings to facilitate process optimization and fine tuning.

Alarms

Volt free contacts shall be provided for interlocks to the main motor, backdrive, and feed pump. The alarm type is indicated on the graphical display or sent to a central system by serial communication. These include:

Alarm Description	Required Action
Torque overload warning	Stop feed
Sunwheel speed error	Shut down centrifuge
Differential speed too low	Shut down centrifuge
Torque overload	Shut down centrifuge
Overspeed	Shut down centrifuge
Motor overheat	Shut down centrifuge

It shall be possible for the operation of the decanter to be remotely monitored and recorded using analog outputs from the decanter controller. As a minimum this would be: differential speed, bowl speed and conveyor torque.

Digital Communication

The controller shall be able to interface with a number of commonly available serial protocols by using separate communication modules or gateways.

Emergency Stop

An emergency stop shall be located on the centrifuge frame and wired back to a common control terminal in an IP65 enclosure.

Cover Switch

A cover switch shall be mounted on the centrifuge frame to prevent the starting of the decanter when the main casing cover is open. The switch shall be wired back to a common control terminal in an IP65 enclosure.

Vibration Switch

A vibration level monitor shall be mounted. The monitor shall provide operator indication of correct operation vibration warning and alarm shut down levels/ The vibration level monitor will send a vibration level signal to the controller via serial communication.

Auto Start and Auto Stop

The Decanter Centrifuge SCP shall be divided into two (2) connected systems, one is the electrical control panel to be erected in a specially erected room in the dewatering building and the control display panel to be erected near the centrifuge in the same building or in the electrical room.

The Decanter Centrifuge SCP shall be equipped with Auto Start and Auto Stop buttons. When the Auto start button is pushed, a programmed inspection shall check the readiness to operate of the following (for the centrifuges and screw conveyors):

- Decanter Centrifuge, including main drive and backdrive system.
- Polymer Preparation and Supply System (System shall register "ready" only when a pre-designated minimum amount of stored polymer solution is ready to be pumped, and the pumping/delivery system is operational).
- Screw Conveyor.
- Centrifuge Feed Pump.

If the inspection confirms that the specified components are ready to operate, the following start-up sequence shall be executed:

1. The SCP shall solicit start-up approval from the plant's CCP, such approval to be withheld if the sludge level is too low. If approval is given by the CCP (via an enable DO), the rest of the Start-up sequence shall be executed.
2. Start Screw Conveyor System
3. Start centrifuge main drive (with timer transferring operation from the drive's start circuit to its run circuit) and backdrive system
4. Programmed time delay to allow centrifuge main drive to reach full speed. (Delay time shall be adjustable from Central Computer).
5. Start Polymer Preparation and Supply System (This step shall begin the pumping of the pre-mixed polymer solution).
6. Start Centrifuge Feed Pumps.

The above Auto Start sequence may also be started automatically from the CCP. In either case, the dewatering operations will continue for the period of time pre-set at the CCP MMI. When this period of time has elapsed, the CCP shall transmit a desirable DO to the SCP. When the SCP receives this DO, the Auto Stop sequence will automatically begin. The centrifuge feed pumps Pump shall be prevented from starting, and, if operating, shall be stopped when the Auto Stop or Emergency Stop sequences below are activated.

When the Auto Stop button is depressed, the following shut-down sequence shall be executed:

1. Stop Digested Sludge pump to Decanter Centrifuge System
2. Stop pumping of polymer solution
3. Programmed time delay (delay time shall be adjustable from SPLC)

4. Stop centrifuge main drive and wait until coast down has been completed
5. Programmed time delay (delay time shall be adjustable from SPLC)
6. Stop Screw Conveyor

Emergency Stop

The SCP System shall be equipped with an Emergency Stop sequence which shall be activated upon the occurrence of any of the following conditions:

- Main drive excessive temperature
- Main drive overload
- Excessive temperature at main bearings
- Failure of back drive system (for eddy current brake systems; failure of eddy current brake; for hydraulic systems; hydraulic motor excessive temperature or overload, excessive oil temperature in system, or low level of oil in the system).
- Excessive vibration.
- Excessive torque.
- Manual depression of the centrifuge emergency stop button.
- Failure of Polymer Preparation and Supply System.
- Failure of either Screw Conveyor.
- Failure of both centrifuge feed pumps

Any of the above conditions shall result in a shutdown of the centrifuge and all other system motors and equipment. The hydraulic back drive lubrication system shall remain in operation during machine coast down (unless it is itself the cause of the required shutdown). The Screw Conveyors shall remain in operation during machine coast down and for a pre-set period of time thereafter, again unless it is itself the cause of the shutdown. Setting the selector switch of any SCP motor (including the PPSS) to Manual shall remove that component from the above Auto Start and Auto Stop sequences, but not from the Emergency Stop sequence.

System Failure

System failure shall be defined as occurring when the Emergency stop sequence is activated. If System Failure occurs, the SCP shall, via a dry contact, transmit a failure alert to the CCP, where a visual/audio alarm will be activated.

Controls

The SCP shall be equipped with the following controls and control functions on the above mentioned separate panel to be erected near the centrifuge:

- Controls for the main drive motor.
- Controls for hydraulic backdrive drive system, if applicable.
- Settings for torque input and rate of change of differential speed and/or differential speed, as applicable.
- Setting of maximum allowable scroll shaft torque.
- Controls for the (hydraulic backdrive) lubrication system.
- Controls for the feed pumps (including frequency converters).

Displays

The SCP shall be equipped with the following displays:

- Digital indicator to display the feed sludge flow rate, in cubic meters and tenths of cubic meters per hour, as measured by sludge flow meters. To include totalizer of this measurement.

Gauge powered from SCP.

- Fault indicator displays for all the conditions leading to an Emergency Stop, as described above.
- Bowl speed, scroll speed, differential speed, scroll torque.
- Eddy current brake current and pinion torque, if applicable.
- Vibration high-level audio/visual alarm.
- High torque audio/visual alarms.
- Main bearing high-temperature audio/visual alarms.
- Display of PPSS solution concentration and dosage rate settings, and the measured polymer flow rate.
- Totalizer for polymer flow.
- Speed of feed pumps (expressed as % of total).

411.9.6 - Polymer Preparation and Supply System (PPSS)

The GBT/DRM thickener supplier and the decanter centrifuge supplier shall supply one (1) complete Polymer Preparation and Supply System (PPSS) to provide an optimal polymer solution for injection into the sludge stream to be thickened to be dewatered. The system shall be capable of preparing a polymer solution to a preset desired concentration from dry polymers, mixing and then transferring the solution to a storage tank, and feeding the solution at a preset dosage rate into the feed sludge stream. The PPSS shall be capable of supplying for dewatering 12 kg of dry polymer for one ton of dry solid. A sufficient polymer solution to the thickener or centrifuge at its maximum capacity. The PPSS to be supplied shall prepare, store and the supply polymer solution at any concentration. All system components shall be sized accordingly and will include a further inline dilution system with either plant effluent or water to achieve the best result of sludge cake.

The supplier shall supply all equipment required for a complete Polymer Preparation and Supply System, safe and completely fit and ready to operate, including all related and auxiliary equipment. It is stressed that the System shall be supplied as a complete unit, and no omission or indication to the contrary in this or in other sections of this Specification or in the Drawings shall be construed as relieving the Contractor from his responsibility to supply a completely automatic Polymer Preparation and Supply System.

The Polymer Preparation and Supply System shall include (but not be limited to) the following:

- Flocculant Powder Feed Hopper for dry polymer powder, equipped with impacttype vibrator and pneumatic feeding system, including all necessary devices required.
- Powder Screw Feeder and Hopper
- Venturi Powder Injector

- Air Blower and Air Dryer, to be connected to the Venturi Powder Injector (Hydraulic systems shall also be acceptable).
- Water Inlet System
- Powder-Water Dispenser with solenoid valve, pressure switch and pressure gauge
- Polymer Preparation Tank, equipped with electrically-driven agitator without coupling, solenoid valve, level sensor for sequence control, mixing timer, and including overflow and drainage piping and valves (for continuous systems, and agitator shall be supplied as required for the tanks.
- Transfer Pump
- Polymer Storage Tank, equipped with electrically-driven agitator, level sensor for sequence control, and including overflow and drainage piping and valves
- Dilution Water System
- Polymer Dosing Pumping Units
- In-line injector (3 on each line)
- Backflow preventer (installed by a licensed installer)
- Polymer Solution Flow Meters for each line
- Local controls and local control panel

Except as specified otherwise herein, all PPSS equipment dimensions, ratings, capacities, sizes and speeds, shall be as per maximum system dewatering requirements, and shall be proposed by the Contractor, based on the results of sample testing.

Automatic Emptying System

If the system supplied is a continuous (and not batch) system, then the PPSS will also include an automatic emptying system. This system will go into action when the PPSS is switched off, allowing the remaining polymer in the tanks to be used up and the preparation of polymer to stop, thus preventing wastage.

This system will be simply operated via the PPSS control system by 2 electric valves, one connected to the systems' main feed pipe and one connected to the system drainage pipe and a connecting pipe between the two (see drawings). Once the PPSS is switched off the electric valve on the main feed pipe will switch off to and polymer will stop being dosed to the centrifuge via the main feed pipe. At the same time the electrical valve on the drainage pipe will open.

Flocculants Powder Feed Hopper

The Flocculants Powder Feed Hopper will be fed by a pneumatic (vacuum cleaner type) feeding system and then shall be attached to the screw feeder by means of a removable flexible coupling. The hopper shall be made of non-corrosive material, and shall be sized to accept and store no less than 30 kilograms of dry polymer.

The hopper shall be equipped with an audio alarm to sound when the hopper has been emptied of polymer. The alarm shall sound at the local control panel of the PPSS and to the central control panel but need not be linked to the Decanter Centrifuge System Control Panel. The alarm shall be manually silenced.

Bridging within the hopper storage area shall be prevented by means of an impacttype adjustable vibrator. The vibrator shall be of sufficient size and vibration rate to assure an accurate feed rate and shall have a dust and moisture resistant cover.

Included in the supply of the PPSS shall be a pneumatic feeding system which shall enable the operator to convey the polymer from the storage sack(s) to the feed hopper without having to lift the sack(s). The feeding system shall include 2"-diameter suction and discharge pipes (of sufficient length to reach from the polymer storage area to the PPSS feed hopper) and a vacuum/blower. The feeding system shall be manually turned on and shall be manually operated. The vacuum/blower shall be of sufficient strength to enable rapid transfer of the polymer.

If a stairway or platform is necessary to enable the operator to safely and conveniently gain access to the feed hopper, the supply of such stairway or platform shall be included in the supply of the PPSS. The stairway or platform shall be securely attached to the feed hopper, and shall be equipped with a handrail and guardrail, as necessary.

Powder/Water Disperser/Eductor

The volumetric dry feeding and dissolving system shall include a Powder/Water Disperser connected to the Air Blower via a Venturi Powder Injector. The Screw Feeder and Hopper shall be mounted above the Injector. Every particle of powdergrade polymer delivered to the Disperser/Eductor by a high velocity air stream shall be wetted in an intense water spray pattern produced by nozzles set in a stainless steel head. The Disperser/Eductor shall ensure that all polymer particles are properly prewetted before they enter the Preparation Tank.

Polymer Preparation Tank

The wetted polymer entering the Preparation Tank shall be mixed slowly until it is completely dissolved. Mixing should then continue for at least 30 minutes to insure that all of the polymer is completely dissolved and to allow for proper aging of the polymer. Volume of tank to allow at least 90-minutes-worth of polymer solution to be prepared based on maximum centrifuges throughput, design solution concentration, and maximum guaranteed polymer usage. The Preparation Tank shall be made 316 stainless steel.

Transfer Pumps

Polymer transfer pump shall be supplied, with electrical motors and all related and auxiliary equipment. The type and materials of construction of the pumps shall be proposed by the Contractor, subject to approval by the Engineer.

Pump rating shall be as per maximum system requirements plus 50%. The pumps shall discharge into the Polymer Storage Tank.

The polymer transfer pump shall be controlled via the local control panel by the level sensor in the Polymer Storage Tank automatically and manually. Pumping shall not occur when the level in the tank is above a preset designated maximum.

Polymer Storage Tank

The Storage Tank shall be made of 316 stainless steel and shall be equipped with level gauge.

Dilution Water System

The Contractor shall supply a complete in-line dilution water system, including all necessary pipework, valves and related equipment. The dilution water system shall be adjusted manually and shall be capable of adding, at a minimum, 4 to 15 liters per minute of dilution water to the polymer solution.

Polymer Dosing Pumping Units

The Contractor shall supply Polymer Dosing Pumping Unit. Pump shall be variable-speed, of the progressive capacity type, rated to the maximum flow of the polymer solution as required by the process, plus 20%. The type and materials of construction of the pumps shall conform with the pump duty and type of chemicals to be pumped.

Changes in the pumps' discharge flow rates shall be effected by frequency converters to be included in the supply of the Centrifuge SCP described below.

All pumps shall be supplied complete, equipped with appropriate valves, flow meters, pressure transmitter and gauges.

Injection of Polymer Solution

It shall be possible to introduce the polymer solution into the feed sludge stream both by way of the feed compartment of the centrifuge scroll or a separate injection port on the machine or by means of an in-line injector. The in-line injection of polymer solution shall be possible at alternate locations in the Digested Sludge piping, including at points 0.7-1 meter upstream, as far as 8 meters upstream, and one intermediate point upstream of the centrifuge. The injector shall be of the venturi type, with at least four- (4) polymer solution entry points around the circumference. A minimum of three (3) spools, conforming to the dimensions of the injectors, shall be included in the supply of the injector for erection at the installation locations specified. Removal of a spool from the pipeline shall allow the insertion of the injector in its place. Injectors shall be designed for easy cleaning.

The optimal location along the Digested Sludge pipe for injection of the polymer solution shall be determined in tests to be conducted when the Decanter Centrifuge System is erected. Such tests are included in the Contractor's supervision of erection responsibilities.

Local Control Panel

The PPSS local control panel shall include the following:

- Running lights for individual motors and for the system as a whole fault indicator lights
- Display of level in the Polymer Storage Tank
- control settings for solution concentration and dosage rate
- Display of polymer flow rate

Outputs from the local control panel to the Decanter Centrifuge System Control Panel shall include:

- Running lights for the system as a whole
- Solution concentration and dosage rate
- Polymer flow rate

411.9.7 - Screw Conveyor

The manufacturer shall supply screw conveyor for the purpose of conveying cake sludge. Included in this item are all related equipment and accessories needed, including motor, drive, structural supports, controls, guards, wash-water solenoid etc. The screw conveyor shall be capable of conveying cake sludge at a rate at least as great as the maximum production rate.

The screw conveyor shall include a center shaft. Furthermore it will include a trough, cover (to extend the entire length of the screw conveyor), fixed inlet hopper, screw drive motor and assembly, pivot mechanism drive motor and assembly, discharge chute, and all necessary controls, guards, structural supports, safety devices, etc.

The Screw conveyor shall be of the double flight type; deflections between standard hanger bearing intervals (such intervals not to exceed 3.5 meters) shall not exceed ¼". Extended grease piping through the trough cover to convenient access points shall be provided. Bearings shall be of the flanged external ball bearing type with grease fitting and external gland seal. Minimum L-10 bearing life shall be 100,000 hours.

The speed gear reducers of the conveyor drive motor shall be V belt or chain belt input to the conveyor drive shaft. Gears shall be at least as per AGMA II (with splash lubrication provided as a minimum). The V-belt or chain belt assembly shall be provided with an FRP guard. The gear reducer and drive shall be provided with an instantaneous trip current relay for torque overload protection.

The screw conveyor cover shall not impede or obstruct the sludge flow and shall be easily removable for inspection and maintenance.

The screw conveyor center shaft, fittings, trough, cover, inlet hopper, and discharge chute shall all be manufactured of minimum 316 stainless steel. All metal parts which are not stainless steel shall be Hot-Dipped Zinc Galvanized.

The screw conveyor shall operate whenever the centrifuge it is serving is in operation and controlled from its control panel. The conveyor shall shut down automatically after the centrifuge it is serving has shut off, but only after a time delay, to permit the removal of all cake sludge remain in the screw.

411.10 - Instrumentation

411.10.1 General

The Contractor under this part shall supply the instrumentation specified below. It is hereby emphasized that the responsibility of the contractor to offer instrumentation equipment provided by the suppliers listed below only.

All instrumentation equipment shall be supplied complete, including primary elements and transmitters. All programmable controllers, microprocessors, and all programming hardware and software needed for the equipment to meet the specifications herein shall be included in the supply of the equipment. The supply of the equipment shall also include all electrical accessories needed, including transducers, isolators, converters, etc., as well as appropriate lengths of cables, suitably armored, to connect equipment components to each other. Also included in the supply of this equipment shall be all hardware and fixtures (including supports, stands, mounting brackets, protective enclosures and coverings, holding fixtures, nuts, bolts, etc.) needed for the complete erection of the equipment.

The Contractor supplying the instrumentation shall be responsible for connecting primary element sensors to their respective transmitters, as appropriate. However, the electrical connection of the instrumentation equipment to the plant's power supply and to the plant's Central Programmable Logic Controller (CPLC) shall be effected under the Erection Contract.

All instrumentation to be supplied shall be suitable for connection to the plant's power supply (220 Volts, 50 Hz, single phase or 24 VDC) and, as appropriate, to the CPLC or an SPLC. Output signals shall be 4 to 20 mA analog. Dry contact relay connections are also specified in some cases.

Unless otherwise specified, instrumentation equipment shall meet the requirements of (at least) IP65. All sensors shall be protected as per DIN 40050 and shall meet the requirements of IP68. In addition, all transmitters to be erected outdoors shall be protected against the sun by an overhead covering. All instrumentation equipment shall include a local indicator to enable local viewing of the measurement being made.

Local indicators not designed to be mounted in pipework shall be independently supported for convenient viewing. Support fixtures and mounting hardware for this purpose shall be included in the supply of the equipment, as noted above.

All instrumentation shall be capable of withstanding fluid and ambient temperatures up to 60 degrees C, and relative humidity of up to 95%.

Sensors, cables and other instrumentation to be erected in closed areas shall be designed for safe use in an explosive atmosphere and shall be made of non-corrosive materials.

For ease of maintenance and plant operations, all instrumentation in each of the subclauses below shall be supplied from a single manufacturer.

Unless otherwise indicated, all instrumentation equipment shall be capable of

automatically communicating to the CPLC or SPLC, as appropriate, a warning that the equipment is unable to report a valid measurement, either because of an internal fault in the equipment or because of a problem with the medium being measured. Such warnings shall include, as appropriate (but not be limited to) loss-of-signal, depletion, and no-flow warnings. Communication may be either 4-20 mA or via a dry contact relay.

All instrumentation shall electronically average readings over a programmed period of time (normally several seconds) to prevent the transmission of unrepresentative, inaccurate peaks.

For all instrumentation supplied for erection below ground level or at or more than 1.50 meters above ground level, the primary element sensor and transmitter shall be physically separate; while the sensor shall be erected at the height required by the design, the transmitter shall always be erected at a location easily visible and accessible from ground level.

The supervision of erection of all instrumentation shall include the complete calibration of the instrumentation as per the manufacturer's instructions. For all analytical instrumentation (solids concentration, dissolved oxygen, pH, etc.) the instrumentation shall be calibrated against samples taken in the field and tested/measured in a laboratory. The calibration of all instrumentation shall be such as to ensure that the requirements of these specifications and the manufacturer's published performance specifications are met or exceeded. The cost of the calibration (including all sampling and laboratory work needed) shall be understood as included in the supervision of the erection of the instrumentation.

Unless otherwise specified the accuracy of all instrumentation supplied shall be $\pm 1\%$ or better.

All instrumentation shall be self-cleaning, requiring cleaning and/or maintenance and/or calibration by plant staff no more frequently than once every two (2) months.

All mechanical wipers and/or automatic rinsing systems (including all necessary solenoid valve(s), pipework, fixtures, devices, adapters, hardware, chemical cleaning systems, backflow preventers, etc, shall be understood as included in the supply of the instrumentation.

Control of mechanical wipers shall be from the instrument itself; solenoid valves, on the other hand, may be connected to and controlled from the plant's Central Control Panel.

411.10.2 - Electromagnetic Flow Meters

General Requirements

Unless the meters are erected below ground level or at or more than 1.50 meters above ground level, the meters shall be of the compact type, with the primary element and the transmitter forming a single unit.

All meters shall be suitable for continuous, in-line measurement. Meters shall be capable, if emergency conditions so dictate, of being submerged without causing

damage to the units.

The local indicator shall display a digital readout (continuous, and updated no less frequently than once per second) of the flow in cubic meters and tenths of cubic meters per hour. The local indicator shall also display the totalized flow, in cubic meters and tenths of cubic meters. (Meters shall be equipped with pulse outputs for transmission of totalized flows).

The flow meter shall be enamel or galvanized and have a tube lining of hard rubber. The electrodes shall be of 316 stainless steel construction and shall be removable for cleaning and maintenance without the need for pipeline shutdown or removal of the meter.

Flow meters installed in pipelines with an internal insulated lining shall be equipped with special grounding electrodes; alternatively, a grounding ring, made of 316 stainless steel, shall be installed between the pipe's flange and the meter's inlet flange.

All flow meter measuring heads shall be properly grounded, by means of a "live" water pipe line.

All flow meters shall be erected with straight run piping of 5 pipe diameters upstream and 3 pipe diameters downstream.

Accuracy shall be $\pm 0.3\%$ of reading.

Flow meters shall be capable of detecting and communicating to the CPLC an empty pipe condition. The Contractor shall supply electromagnetic flow meters for the following applications. Equipment identification numbers precede each application description.

In addition to communicating 4-20 mA flow measurements to the Central Control Panel, shall also transmit 4-20 mA flow measurements and totalized flow pulse outputs to the Automatic Sampler. The Sampler shall totalize these measurements and, when in its flow mode, take samples of the plant influent based on these totalized measurements.

The Contractor shall supply electromagnetic flow meters for the following applications:

One (1) unit for the measurement of RAS.

One (1) unit for the measurement of waste activated sludge (WAS) pumped to the Sludge Thickener.

One (1) unit for the measurement of plant effluent.

411.8.3 Ultrasonic Liquid Level Gauges

General Requirements

All units mounted in tanks and manholes shall be erected away from walls which may interfere with the measurement.

Accuracy shall be $\pm 0.5\%$.

Transducers shall be suitable for use in a highly-corrosive atmosphere and includes separate controller with display and 2 relays. The design of the transducer holder assemblies shall permit easy maintenance and, if necessary, replacement of the transducers.

All units shall be supplied with a lock-out feature (key, password or detachable programmer) to prevent unauthorized changes of set-up inputs.

All units shall convey loss of signal warnings to the CPLC.

All units will be protected with IP68 protection.

2 wire units is not accepted.

411.10.4 - Solids Concentration Meters

General Requirements:

Solids concentration meters shall measure the concentration of suspended solids in the sludge or wastewater stream using optical technology. Meters shall consist of a measuring probe (equipped with 2-beam alternating infrared emitting diodes and 4 photo detectors), a separate electronic transmitter, and the necessary interconnecting cabling. Meters shall automatically compensate for contamination, temperature and sensor aging, and includes mechanical self cleaning device.

The measuring probe shall be designed for mounting (as specified) either in a pipeline (through a custom ball valve assembly to be supplied with the unit) or in a basin or manhole. Probes and cabling shall be made of non-corrosive materials. The connection between the probes and the transmitter shall be watertight.

The transmitter unit shall display the solids concentration as a percent and in mg/l. In addition to its 4-20 mA output signal, the transmitter shall include an alarm (relay) contact for indication of probe signal depletion. The transmitter shall be housed in a NEMA 4X enclosure.

The Contractor shall supply solids concentration meters for the following applications:

One (1) unit for the measurement of the solids concentration of the RAS.
Measurement to be made in the RAS pipe line. Solids concentration range: 0.8 - 1.5%.

One (1) unit for the measurement of the solids concentration of the thickened sludge to the sludge holding tank. Measurement to be made in the discharge pipeline of the digester Feed Pumps. Solids concentration range: up to 5%.

411.10.5 - Dissolved Oxygen Meters

Dissolved oxygen meters shall measure the concentration of dissolved oxygen in the three Aeration Tanks. Sensors shall be of the optical DO type. Each meter will also include a separately mounted electronic microprocessor, analyzer/transmitter, housed in a NEMA 4X (IP65) weather-proof corrosion-resistant enclosure, complete with the necessary interconnecting cabling. Meters shall automatically compensate for temperature. The sensor can be exposed to direct sun light without any damage. Expected life without maintenance – up to 5 years.

The Contractor shall supply dissolved oxygen meters in aeration tanks one in the aerobic zones and one in the anoxic zone.

At each measuring station, one (1) D.O. meter and sensor shall be installed. Measurements taken at all stations shall be transmitted (via 4-20 mA) to the plant's CPLC.

The sensors (and accompanying signal cables) shall be equipped with a suitable support structure made of stainless steel. To enable the erection of the sensors at adjustable depths in the tank, at a distance of approximately one meter from the edge of the tank.

The sensors and signal cables shall be corrosive-resistant. The connection between the sensor and the electronics unit shall be waterproof as per IP68.

The sensor shall be equipped with an integrally flash system with air, to maintain accurate measurement for the sensor life.

The transmitter shall display the dissolved oxygen concentration in mg/l. The display shall indicate the measured value in engineering units, temperature, and alarm status and fault conditions. The alarms shall operate via a time delay to ignore temporary upsets.

411.10.6 Automatic Sampling Units:

General :

For the Eron WWTP, two automatic samplers shall be installed. One unit to be located in the inlet pumping station, while the other unit shall be situated so as to sample the final effluents. The sampling unit shall be based on a corrosion - resistant refrigerated automatic sampler that extracts a sample from the process by means of a vacuum suction pump, and preserves this sample at 4 °C.

Process :

- Medium : Wastewater, untreated influent and final effluents
- Temperature (min/nom/max) : 5/20/45 °C
- pH : 5–9
- Conductivity : 1,000–3,000 micromho
- Total suspended solids : 300–1,000 mg/l

Sampler :

- Type/model : To be determined by the Contractor
- Process mounting : Floor-mounted
- Chest : Enclosed construction with an outer white UV-resistant glossy gel vinyl foam coat
- Protection level : For outdoor installation (all weather)
- Power supply : 230 VAC, 50Hz
- Cooling : Yes, controlled by means of a thermostat
- Temperature control : Normally 4°C, control range 0–20 °C

- Sample initiator control with the possibility of operating in the following modes:
 - Flow proportional
 - On adjustable timer
 - On adjustable passed pulses
 - 4–20 mA from an external source
- Suction height : 5 m
- Vessels : 24 one-liter PP bottles

411.10.7 pH Meter / Conductivity Meter

The Contractor shall supply one (1) pH meter and one (1) Conductivity Meter for erection in the inlet pumping station of the plant.

The basis of operation of the pH Meter shall be the comparison of the electric potential generated across a glass membrane against a reference electrode. The difference shall be amplified by an electronic signal conditioner. The local display shall be in units and tenths of units of pH. (differential electrode only).

The pH Meter shall be supplied complete, including glass electrode wire, glass membrane, process fluid, reference electrode fill solution, and reference electrode wire. The pH Meter shall be equipped with a submersion-type electrode assembly with an integral preamplifier. The electrode assembly shall be attached to a S.S pipe with a bracket for mounting on a guardrail. The bracket shall be designed such that the pipe and electrode assembly can be removed for maintenance without the use of tools. All fastening devices shall be secured to prevent them from being dropped into the channel. The signal conditioner/transmitter shall be mounted next to the electrode assembly mounting bracket. Enough spare cable shall be supplied to allow the sensor/pipe assembly to be lifted clear of the tank.

The pH Meter shall include automatic temperature compensation through the use of a temperature sensor in the process fluid which shall adjust amplifier gain to compensate for changes in electrode gain caused by temperature.

Performance requirements shall be as follows: accuracy, ± 0.1 pH units; repeatability, ± 0.03 pH units; and stability, ± 0.02 pH units per week.

Conductivity measurement sensor shall be of conductive type made of P.P. range 50-2,000,000 (micro siemens) accuracy. The sensor will have integral temp. compensation element mounting hardware will be as the PH.

411.10.8 - Air Flow Meters

The Contractor shall supply Air Flow Meters for measuring the inlet air flow to the aeration tanks. One meter will be installed for each tank. Each unit shall be capable of measuring air flow rates of 5,000-12,000 m³/h. The air flow meter shall be installed in the main air supply pipe to each of the tanks.

The air flow meters supplied shall be of thermal mass flow meter type. The meters shall be flow-measuring devices consisting of an insertion probe with heating element and temperature sensor for measurement of air flow without need to compensate pressure or temperature changes.

The unit shall provide local readout of the measured air flow rate and a 4-20 mA air flow rate signal to be transmitted to the plant's CCP. units shall be actual cubic meters of air per hour (m³/h).

Accuracy of meter (including all components) shall be $\pm 1\%$; of reading repeatability $\pm 0.2\%$. The sensor shall be of minimum 316 stainless steel. The unit shall include all necessary piping, valves, gaskets, fittings, all of which shall be 316 stainless steel. Meters shall be suitable in all respects for the aeration application described above. Max working temperature 1210 c. Power supply VDC.

411.109 - Ammonia meter

The contactor shall supply Ammonia meter.

One ammonia meter shall be installed in each biological reactor. The measuring principle shall be based on a selective ion electrode with a continuous cleaning device and potassium (k+) compensation.

The concentration of ammonia in the mixed liquor shall determine the required dissolved oxygen level in the reactors. Since the amount of energy required for aeration is directly in relation to the oxygen level, the ammonia level also is a very important instrument. Therefore the proposed system for detecting ammonia must be extremely reliable and shall include an automatic cleaning system. Instrumentation that does not conform to these requirements shall not be accepted.

Sensor shall be of the ion selective electrode type, integral with analyzer. The meter will also include a separately mounted electronic microprocessor, analyzer/transmitter, housed in a NEMA 4X (IP65) weather-proof corrosion – resistant enclosure, complete with the necessary interconnecting cabling. Meters shall automatically compensate for temperature and for pressure (to maintain proper tension on the membrane).

The ammonia meter shall include an automatic cleaning system with air or water type. No chemicals shall be required. (clearing head and control is part of the supply on this chapter).

The ammonia meter shall have automatic calibration with standard calibration solution.

The ammonia meter shall include digital measuring.

Measurements taken shall be transmitted (via 4-20 mA) to the plant's CPLC.

The sensors (and accompanying signal cables) shall be equipped with a suitable support structure to enable the erection of the sensors at adjustable depths in the tank, at a distance approximately one – meter from the edge of the tank.

The response time of the sensor shall be less than 180 sec for 90% of the range.

The sensors and signal cables shall be corrosive – resistant. The connection between the sensor and the electronic unit shall be waterproof as per IP68.

The transmitter shall display the ammonia concentration in mg/l as N. the display shall indicate the measured value in engineering units, temperature, alarm status and fault conditions. The alarms shall operate via a time delay to ignore temporary unsets.

The meter shall satisfy all the requirements of Sub-clause (a) above. The meter shall be equipped with rechargeable batteries and associated charging equipment. The cable between the sensor and the transmitter shall be at least 5 meters long.

411.10.10 - Chlorine measurement

The contractor shall supply one (1) total chlorine meter for measuring the concentration of total chlorine in the contact tank.

The contractor shall supply one (1) total chlorine for measuring the concentration of residual chlorine in tertiary effluent.

Specification for chlorine measurement:

Sensor	Colorimetric multi spectrum sensor
Cell clearing	Automatic cell cleaning mechanism
Mixing technology	Inner solenoid activated active mixer
Display range	0-10 ppm free 0-5 ppm total
Reagent container	500 ml
Reagent type	DPD1 and/or DPD2 or DPD4
Reagent use per sample	Approximately 0.03 ml
Measuring interval	2-10 min (free chlorine) 2.5-10 min (total chlorine)
Reagent replacement interval	1-2 months
Reagent shelf life	1 year unmixing, 2 months mixed

Sample preparation principle: the sample will be conveyed by a "fast loop" to the micro filtration system for suspended solids removal.

The fast loop system shall include the supply of all the necessary piping, the pump, the pump base, the pump guide rails and necessary Accessories (pressure gauges, non return valves, isolation valves, quick release couplings, pressure regulating valves, fittings etc.).

No. of fast loop sampling pump type: one per meter. (total of 2).

Discharge of fast loop pump: min 5.0 cu.m/hr.

Pressure of fast loop pump: 1.0 atm. in excess of the required by the micro filtration unit.

411.10.11 - Turbidity meters

General Requirement

Turbidity meters shall measure the turbidity in the effluent stream using optical technology. Meters shall consist of a measuring probe (equipped with 2 – beam alternating infrared emitting diodes and 4 photo detectors), a separate electronic transmitter, and the necessary interconnecting cabling, and self cleaning device.

Meters shall automatically compensate for contamination, and sensor aging. The same system should be capable to measure solid concentration or turbidity field selectable.

The measuring probe shall be designed for mounting (as specified) either in a pipeline (through a custom ball valve assembly to be supplied with the unit) or in a basin or manhole. Probes and cabling shall be made of non-corrosive materials. The connection between the probes and transmitter shall be watertight.

Probes in basin will be fully protected from pump turbulence and easily accessed for maintenance.

The transmitter unit shall display the solids concentration as a percent and in mg/l. In addition its 4-20 mA output signal, the transmitter shall include an alarm (relay) contact for indication of probe signal depletion. The transmitter shall be housed in a NEMA 4X enclosure.

The contractor shall supply two (2) turbidity meters for the tertiary effluent 0-5 NTU. (before and after tertiary treatment).